ELECTRICAL REVIEW

27 MAY 1955

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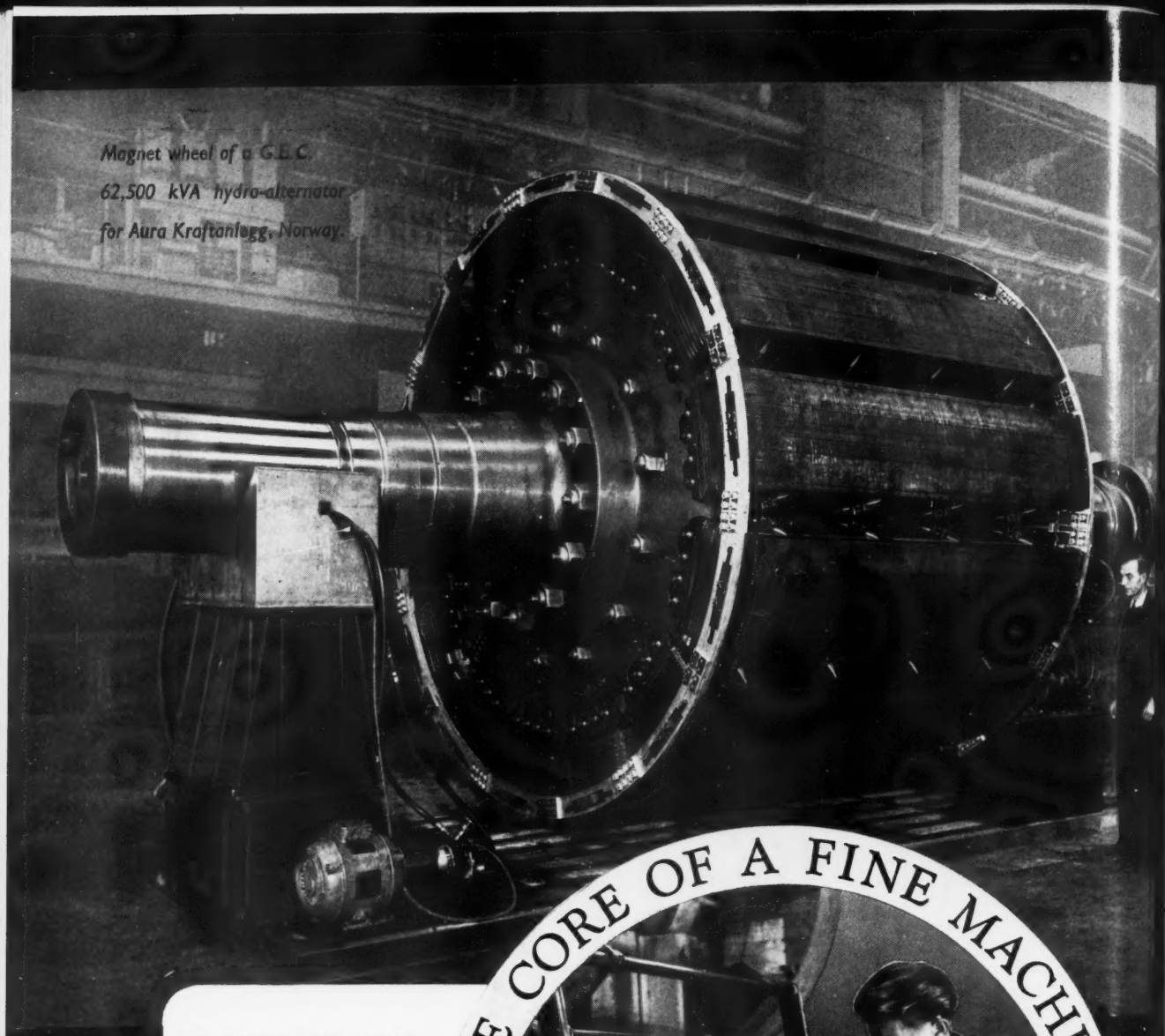

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27 MAY 1955

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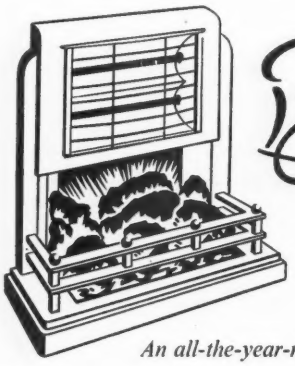

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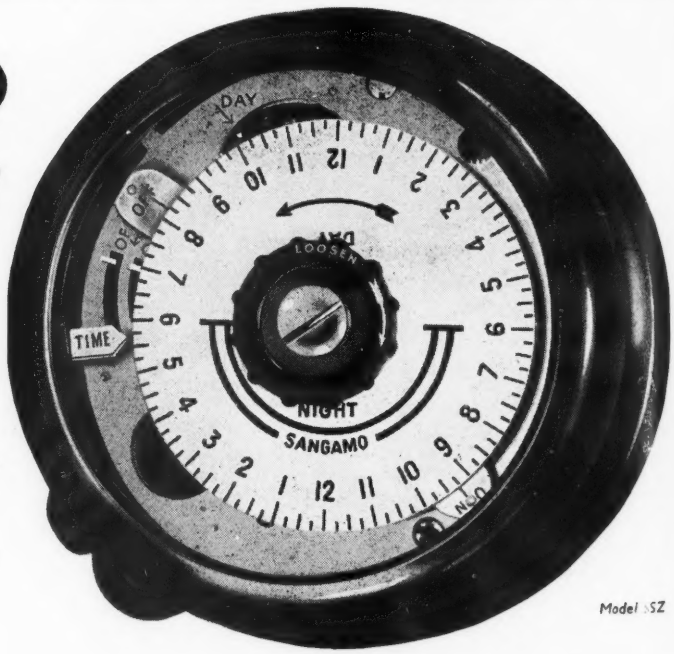

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ELECTRICAL REVIEW

27 May 1955 Vol. 156 No. 21 Established 1872

Is Overtime Necessary?

TIME was when overtime was considered necessary only when there was extra pressure on a works. It added to production costs and was not indulged in if it could be avoided. Since the war the apparent shortage of labour has necessitated regular overtime in many industries, particularly as shorter regular working weeks have been instituted generally. Commonly the hours deducted from the normal week are still worked at overtime rates in spite of understandings (if not undertakings) that as much would be done in the shorter week.

Unfortunately overtime has come to be relied on by many workers as a means of increasing their earnings and often, we fear, is an inducement to men to spread their work over longer periods. This was one of the subjects discussed at last week's conference of the Electrical Trades Union and it was handled in a way not likely to advance the interests of the electrical industry or do the country any good. Generally speaking, the view of the Union's executive, which was endorsed by the delegates, was that less work for more money was the object to aim at, all other considerations being subordinated to that aim. The means of achieving this were to secure a shorter working day at higher rates and abandon overtime. Hitherto it has seemed that the Union's agitation for fewer working hours has been made not to give members more leisure time but to turn the saved hours into " time and a half." But now the need for more recreation is stressed.

As the Union is constantly striving to restrict entry to the branches of the industry with which it is concerned it would appear that only extra effort within a shorter working week would prevent an accumulation of arrears of work or the refusal of contracts which could not be carried out. Such a brake on expansion would ultimately be as detrimental to members of the E.T.U. as to their employers and the community.

It must be put on record that there is not unanimity in the Union on the subject of overtime. Some speakers said that members welcomed it and actually sought for jobs where overtime was regularly worked. We are not sure that we approve this attitude either. What is needed is a fair day's work for reasonable pay with overtime only when a job cannot be finished by honest effort within normal hours.

LONDON'S ELECTRICITY LOAD

The paper on "The Supply of Electricity in the London Area" which was presented by Mr. D. B. Irving (London Electricity Board) to the Institution of Electrical Engineers on 18th May (*Electrical Review*, 20th May) is a reminder that the electricity load density in London is greater than that anywhere else in the world, with the possible exception of a part of New York. This was brought home to us during the preparation of our load building articles in 1947. Mr. Irving says that the London Area is less than one-tenth of the size of the next smallest Area, that it has a population of five million, and that the population density is more than twenty times that of any other area. We think, however, that the exceptional load density requires a somewhat fuller explanation than is given by these statistics. In addition to the heavy industrial and domestic loads in the outer districts there are the special electricity supply problems brought about by the unique characteristics of central London into which there is an influx of about a million office workers every working morning and their replacement each evening by about the same number of visitors to the cinemas, theatres, hotels, restaurants and clubs. These unique conditions call for special measures of distribution, etc., which were outlined in the *Electrical Review* of 26th February, 1954.

PEACEFUL USES

In Geneva next August there is to take place what is believed will be the greatest international scientific Congress ever held. Over sixty countries are sending representatives to the Conference on Peaceful Uses of Atomic Energy at which, it is expected, about a thousand papers will be presented. Great Britain as the leader in this field is naturally looked to for guidance and British work and experience in the development of radio-isotopes and nuclear power will be well presented. The United Kingdom Atomic Energy Authority is arranging two exhibitions at Geneva during the Conference. One will be of a purely scientific character, intended principally for the delegates. It will be concerned mainly with nuclear reactors for research and power generation and with instrumentation. The other display is designed to instruct the public and will deal in a popular way with Great Britain's first atomic power station (Calder Hall), the ten-year power station programme, the applications of isotopes in industry, medicine and agriculture, and nucleonics; British firms, including electrical manufacturers, will participate in this exhibition.

DOMESTIC HOT WATER

In this issue the technical manager of the Coal Utilization Council writes to us about our recent comparison of the cost of providing domestic hot water, using a heat pump in its earliest infancy, or a conventional system based on a solid-fuel-fired boiler. We feel that in regarding the heat pump as a "competitor" of solid fuel he sets off on the wrong foot. In the best interests of the country the quest is for the most efficient use of our available coal resources. If low grade coal can be burned centrally and used via electrical distribution and a heat pump to produce hot water or space heating equivalent to that produced by the same amount of higher quality solid fuel burnt individually then it would appear that the Coal Utilization Council should encourage the heat pump development and advocate its treatment for taxation purposes in the same way as any other fuel saving appliance. At present the actual coefficient of performance achieved with these early models is only half the ideal and it would belie the past record of our manufacturers were this not to be bettered in a few years' time. Apart from the efficient use of our coal resources, the increased use of systems so much cleaner than those using coal or coke can only be a boon both in the home and generally.

ACCIDENT PREVENTION

The fact that so few electrical accidents occur in industry although electrical applications are ubiquitous is proof of the fact that generally, with the exercise of common sense, electricity is perfectly safe. But common sense on the part of the operators of electrical equipment is not enough; it has to be exercised by the designers, makers and installers of the apparatus and the Factory Regulations put the onus of seeing that equipment is safe upon the factory owner or occupier. In this issue Mr. F. Murgatroyd, one of H.M. Electrical Inspectors of Factories, makes a brief study of the subject of electrical accidents and the ways in which they can be avoided. Remarking that although the use of electricity in industry has been quadrupled in the last twenty years there has been no corresponding increase in the number of reportable electrical accidents, Mr. Murgatroyd gives credit for this to the makers of British electrical apparatus for their high standard of design and manufacture. He also pays a tribute to all those whose work to ensure safety has had such good results.

INSTALLATION INSPECTION

With the object of ensuring safe electrical installations and appliances an Organizing Committee was set up in 1949 to establish a National Inspection Council for Electrical Installation Contracting. Because of difficulties encountered in the negotiations it was not until February last that the Committee could report that agreement had been reached between the sponsoring bodies. Now it is able to announce that it has successfully discharged its terms of reference and has handed over responsibility for the Council's formation to a National Inspection Board-designate. This Board, which will look after the day-to-day business of the Council, has already held its first meeting and, as reported elsewhere in this issue, Mr. P. V. Hunter has been elected chairman. Mr. Hunter's interest in the subject is well-known; besides being chairman of the I.E.E. Wiring Regulations Committee he has held the chairmanship of the National Register of Electrical Installation Contractors since the Register's earliest days. It was stated at last week's E.T.U. conference that the Union had agreed to support an independent inspection body "because of failure to secure statutory enforcement."

Electrical and Mechanical Services

LONDON Airport is certainly the largest and busiest air terminal in Europe and is among the largest operating in the world; its development as a unified operational entity under the close control of a single Government Department makes it even more outstanding among the great airports of the world. Credit for the close-knit organization seen at work to-day goes to the Ministry of Transport and Civil Aviation and the Directorate General of Works (Chief Mechanical and Electrical Engineer's Division) at the Air Ministry, which has been responsible for the detailed planning of the extensive mechanical and electrical services described in this article.

Much of the equipment has been in service for a number of years, some is in course of installation, some is only now being planned, but the stage has been reached when the experiments and development actively carried out by the mechanical and electrical staff have led to the comprehensive schemes now almost completed. This, coupled with the opening for service last month of the new control tower and passenger handling buildings, makes the present time a most suitable one for this account.

Transfer to New Buildings

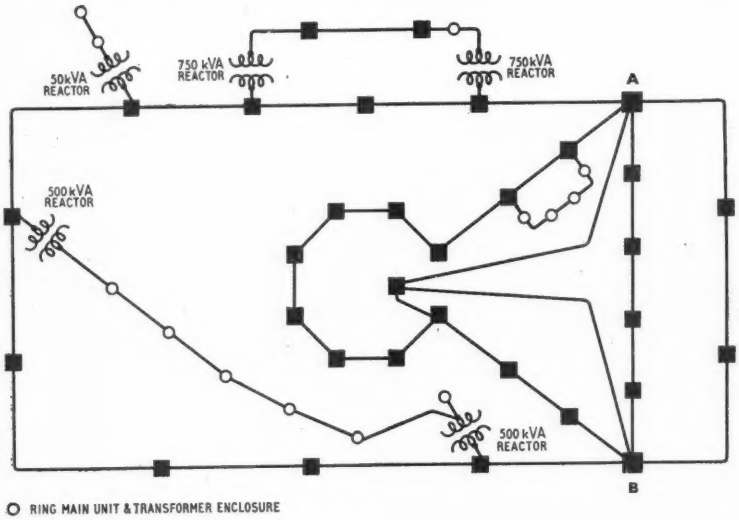
Since 1946 the airport has been controlled and all passengers handled through buildings along the Bath Road. In a single operation, without upsetting flight arrangements, all these facilities, with the exception of the long distance passenger handling, were moved to new premises, in the centre of the airport, where the control equipment provided is very much more intricate than before. It says a great deal for the controllers, and the technical staff that all went smoothly and no tempers were lost. On the occasion of our visit the new facilities had been in use for only 16 hours and although it would not be true to say that all was completely calm and untroubled behind the scenes, nevertheless to the pilot and the passenger any difficulties were not evident.

The airport layout diagram on page 910 shows the runways, the maintenance areas, central buildings and approach tunnel. The runway areas are shown divided into blocks by crosswise lines—these represent divisions for aircraft ground movement control and will be explained later.

Another diagram shows the high-voltage distribution over the area. Supply is obtained from the Southern Electricity Board via two substations on the north and south sides of the airfield respectively. In the northern substation four S.E.B. 22 kV, 500 MVA switches of B.T.H. manufacture control the intake from the North Hyde substation, a feed to the South Airport substation and two 5,000 kVA 22/11 kV transformers. In the southern substation there are two 5,000 kVA 22/11 kV transformers, a feeder to Staines, another direct from North Hyde and a tie to the northern substation. Control of the 22 kV gear is normally in the hands of the S.E.B. but facilities have been given to the airport staff to operate it in an emergency, under instructions from the Board. About 140 11 kV 250 MVA indoor circuit-breakers are distributed in the 11 kV substations all over the airfield.

In the intake substations each 11 kV double busbar board has eight Ferguson Pailin units each with twin breakers in a common tank. An outer 11 kV ring goes more or less round the airfield perimeter, and an inner ring round the central area. The key substation in the centre is that inside the control tower. The right-hand cross tie between the two intake substations feeds the maintenance area in which are situated the new hangars and workshops of B.O.A.C. and B.E.A. The central

Airfield control room



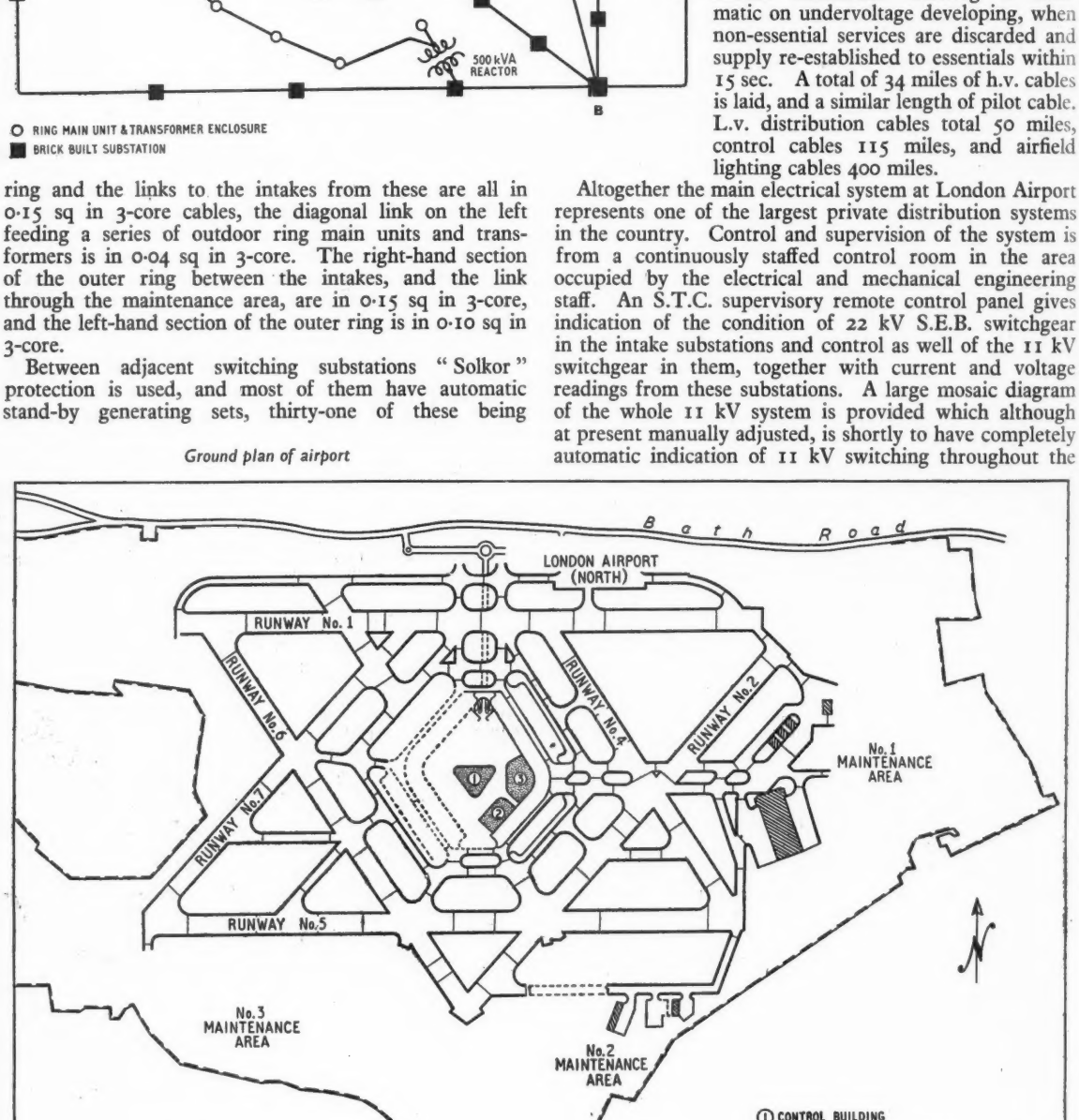
London Airport 11 kV supply system. A & B represent the main 22 kV intakes

ring and the links to the intakes from these are all in 0·15 sq in 3-core cables, the diagonal link on the left feeding a series of outdoor ring main units and transformers is in 0·04 sq in 3-core. The right-hand section of the outer ring between the intakes, and the link through the maintenance area, are in 0·15 sq in 3-core, and the left-hand section of the outer ring is in 0·10 sq in 3-core.

Between adjacent switching substations "Solkor" protection is used, and most of them have automatic stand-by generating sets, thirty-one of these being permanently installed. At a large airport such as this the failure of supply at any substation could have disastrous results if the runway illumination was thus cut off at the moment an aircraft was landing. Diesel alternator sets started by battery driven motors are used, the output being 27·5 or 55 kW depending on the substation concerned. Starting is automatic on undervoltage developing, when non-essential services are discarded and supply re-established to essentials within 15 sec. A total of 34 miles of h.v. cables is laid, and a similar length of pilot cable. L.v. distribution cables total 50 miles, control cables 115 miles, and airfield lighting cables 400 miles.

Altogether the main electrical system at London Airport represents one of the largest private distribution systems in the country. Control and supervision of the system is from a continuously staffed control room in the area occupied by the electrical and mechanical engineering staff. An S.T.C. supervisory remote control panel gives indication of the condition of 22 kV S.E.B. switchgear in the intake substations and control as well of the 11 kV switchgear in them, together with current and voltage readings from these substations. A large mosaic diagram of the whole 11 kV system is provided which although at present manually adjusted, is shortly to have completely automatic indication of 11 kV switching throughout the

Ground plan of airport



airport. On the control board indication and alarm is given on the failure of the main supply at any key sub-station, and another indication shows that the stand-by plant has come into service. Alarms are also provided to show up various faults should the stand-by plant fail.

This control room is in constant touch with the other airport controls, and deals with all electrical and mechanical faults in the area—from a lamp failure to the destruction of any main services should an aircraft crash. Radio contact is maintained with service trucks.

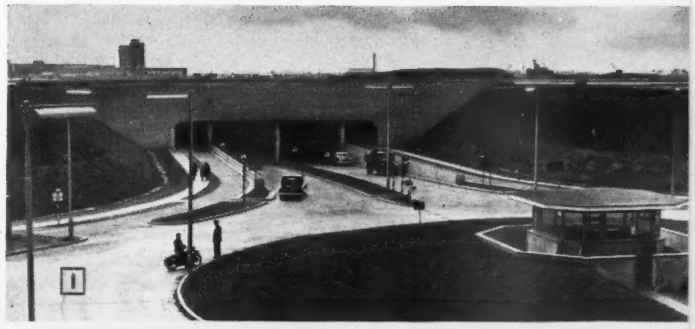
In the 11 kV substation the equipment generally comprises a three, four or five unit 11 kV switchboard, an 11,000/415 V transformer of 100-500 kVA depending on the needs of the area, a six- or eight-way l.v. feeder pillar, in most cases a diesel stand-by set, and control equipment for the local airfield lighting. The total installed kVA of distribution transformers on the airfield is about 27,000, of which about 3,250 with a maximum load of 800 kVA has been installed in the central area for convenience of construction; and 8,000 kVA installed in the B.E.A. and B.O.A.C. areas where the combined maximum load is only at present about 2,200 kVA. Ample reserve against development is thus available in these areas. Over the whole airfield to date the maximum demand is 6,100 kVA and the consumption about 3,100,000 kWh monthly.

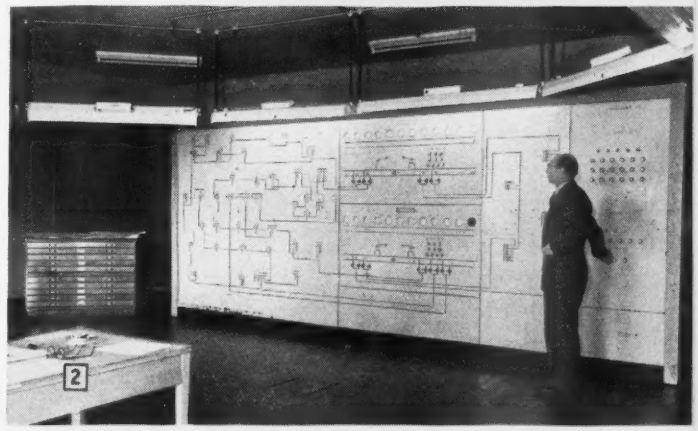
In the central area an 11 kV board on the ground floor of the control tower serves two 500 kVA transformers in the control tower itself, two of 750 kVA in the existing S.E. Face passenger building and one of the same size in the E. Apex building. This board will also supply in an identical way the other three face buildings and the W. Apex building when these are constructed. The transformers in all these buildings are housed in completely enclosed compartments served by individual ventilating systems, and have automatic CO_2 protection in the event of fire, as has the 11 kV switchroom in the control block. Ordinary supplies for all buildings are taken via l.v. switchboards close to the transformer concerned but essential services throughout the buildings are taken from a single board in the control block. This is fed, on failure of the supply, from a 250 kVA Blackstone/G.E.C. diesel alternator set automatically started by compressed air. Immediately on failure of supply a 240 V battery feeds selected lights throughout the building and is disconnected again once the stand-by set is in full operation, this being about 15 sec after the supply has failed.

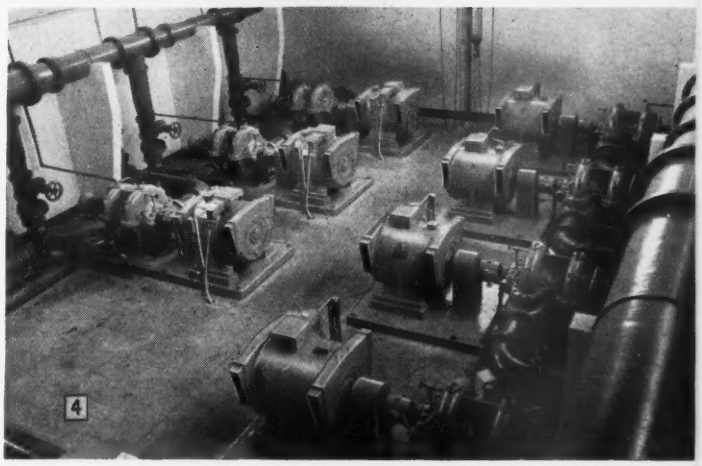
Airfield Lighting

This can be divided into three groups: street and floodlighting in terminal areas; approach and runway lighting; and aircraft movement lighting. The first group calls for little comment: about 300 G.E.C. fluorescent street lighting fittings with three 80 W tubes per fitting are used, the design being such that no light is emitted above the horizontal plane. The aircraft apron in front of the terminal building is lit at night by seventeen floodlighting towers each with seven 1,000 W tungsten lamps to give an intensity in the parking areas of 0·5-1·5 ft-candles but leaving the central approach lane between the two parking lengths in comparative darkness so that routing lights will show clearly to pilots.

The approach lighting with one exception consists on the two east-west runways of a straight line of lights 3,000ft long leading to the start of the runway, with cross-bar lights at right angles to this line every 500ft. Under the worst visibility conditions white directional lamps of







(1) *Entrance tunnels to central terminal area.* (2) *11 kV supply control room.* (3) *Tunnel drainage pump house.* (4) *Fire pump house*

high intensity (500 W) are used and under better conditions red omni-directional lights of lower intensity. Some of the arrays are illustrated here. The other runway approaches at present have only the red low intensity lighting. The exception on the east-west runways has fittings of a much lighter design and of 24 V 200 W rating on high intensity. An important consideration with approach lighting close to the runway ends is the "frangibility" of the structures involved, it being desirable that they should give way easily in the event of an aircraft either under- or over-shooting the runway.

Along the runways themselves a twin line of white lights 150ft apart marks the landing or take-off path of the aircraft, and each threshold of the runway is marked by a crossways line of green lights. As the fittings used for these purposes may be run over by the wheels of the aircraft, special fittings are used let into the concrete of the runway, and projecting only an inch or so. The design of these is of some importance as it is quite possible for the wheels of an aircraft to bounce on one before landing, and the shock to the wheel when passing over the projections at 100 m.p.h. must not cause damage to the tyre.

Taxiway Lights

Once an aircraft has landed it has to be guided to the apron in front of the terminal building required, and this is done at night by a line of flush green lights not more than 80ft apart running down one side of runways and the centre of taxiways. Fig. 1 shows these divided into blocks and individual control of the route lights in each block is available. There are about 100 blocks, of which half are junction points where individual control is available of the route lights on each path into or out of the junction. At every intersection of routes a line of red lights known as a stop-bar is placed across at every point where one route could clash with another.

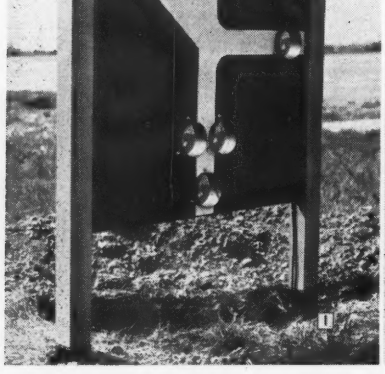
By day taxi-ing is achieved by visual route boards at the sides of the runways and taxiways, bearing the numbers of the various blocks. Aircraft are also guided by radio instructions as to the route. This is to be reinforced by the provision on route boards of twin route and red lamps of high intensity, on each route shown on the board. The two red lamps simulate the red stop bar and the white lights the green taxi circuit. Provision is being made for the interlocking of the red and white lights in a similar manner to that of the green taxi and red stop bar lighting, so that a through route cannot be provided when a stop signal is showing.

Control of the approach and runway lighting and the aircraft movement lighting is by the Standard Telephones & Cables unit control system. It is beyond the scope of this article to describe the system in detail but the essentials are a central control apparatus block linked by 14- and 54-pair cables on a ring round the airfield to 16 controlled centres in airfield substations where lighting control is installed. A digital code principle is employed to avoid the cost of cables with an unwieldy number of cores. The signalling codes are initiated by the central apparatus on the first floor of the control tower and each controlled centre translates the signal received into the required switching function. Back indication checks are carried out as signalling proceeds. The whole system is battery operated to guard against even a temporary interruption of the supply.

For operational purposes the approach and runway lights, and the aircraft movement lighting, are separately controlled from panels, some of which can be seen on the extreme right hand in our illustration of the airport control room. Three or more stages of brilliancy can be selected on the runway lighting by varying the input to a saturable core reactor, and the low or high intensity lights at the approach to the same runway. A master selector chooses the runway, subsidiary keys select the lighting required, and a pulse key initiates pulsing via the unit control system.

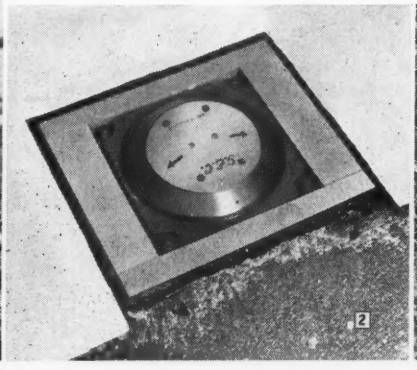
Aircraft movement lights are all of 6 V 36 W rating and are fed via transductors, the control circuits of which operate at 50 V d.c. for "suppression" purposes. At each substation lighting control relays, in turn operated from the unit control system, switch a combination of 50 V a.c. control circuits which pass to multi-unit rectifier panels converting the a.c. control currents to the 50 V d.c. required for suppression. The normal condition of this lighting when nothing has been selected on the control panel, is that the 50 V transductor control supply is in circuit to all the green route lights, these therefore being out; and the control supply to the red stop-bar lights is disconnected so that all routes are stopped. Each straight section of route can be selected and for every junction two rotary selection switches are used, each having a position corresponding to every route meeting at the junction. The controller moves these in turn, at each junction selecting the route in on one switch and the route out on the other, then the same for the straight section or the next junction, whichever is involved. Once a route right through a junction has been selected the green route lights come on and the red stop bars are removed on the lane selected.

Indication that power is flowing to any lamp or set of



(1) *Aircraft movement daylight routing board.*

(2) *Flush lighting fittings used on runways.* (3) *New type approach lighting units*



lamps is via current transformers in the power circuits concerned. At present this is a negative indication, the non-operation of a circuit selected bringing up a red lamp on the control desk. Eventually positive indication will be given by the lighting of the appropriate lamp in the mimic diagram.

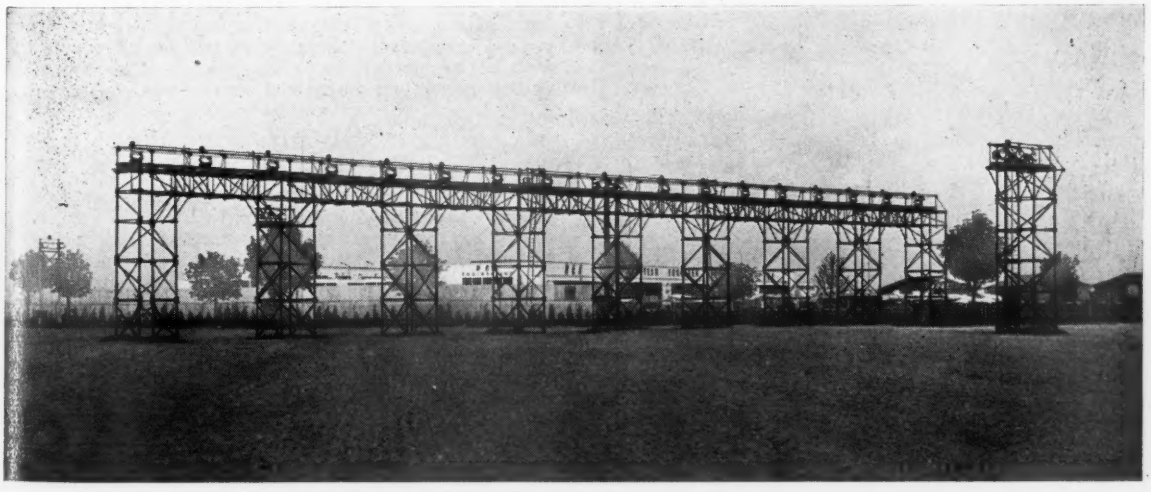
Supply to the groups of fittings is from 600/1,300 V constant current regulators feeding the individual lighting transformers (approximately 8/6 V) in a series circuit. Various over-riding facilities are available to enable stop bar lights to be energized on all routes into a runway in use and those on the runway itself extinguished. Two stages of brilliancy are available covering all the routing lights together.

At present just over 7,700 lighting fittings are in use on the airfield, giving some idea of how complex are the control arrangements.

S.T.C. control gear is also in use in connection with the main tunnels to the central terminal area. Entrance to these is controlled by traffic lights at each end, normally left at green. Contact strips at each end and a summator system will make it possible to keep a continuous check on the number of vehicles in the tunnel at any one time, and to switch the traffic lights to " stop " if a fixed number should be exceeded, with automatic reversion to green when the number is reduced. In the case of a blockage in the tunnel, due to an accident for instance, the use of the local fire push buttons situated at intervals throughout the length, initiates " stop engine " signs inside the tunnel, flashes red lights at the entrances and brings the traffic lights to red. A carbon monoxide indicator in the lowest point of the tunnel brings the ventilating fans into service to change the air. There are two of these, each driven by a 100 h.p. motor, for each tunnel, supplying air via a channel under the cycle tracks which flank the road tunnels, and grilles in the walls of the road tunnels themselves. Fluorescent lighting is used in all these tunnels, the frequency of the fittings increasing towards each entrance and exit.

Drainage from the tunnels is into a buffer tank below ground near the approach island, seen in one of the illustrations. Under the small building in the centre of the picture which houses control gear for the tunnel traffic system referred to in the previous paragraph, is a pump house on two levels, the upper half containing pump motors and electrical control gear, also illustrated, and the lower half the pumps. Under normal conditions two 20 h.p. 960 r.p.m. 625 g.p.m. pumps control the level of the buffer tank, delivering surplus water to local balanc-

(1) Apron floodlighting tower, with a fluorescent roadway lighting column on the left. (2) Close-up view of fittings on approach gantry. Below : Approach lighting at east end of No. 5 runway



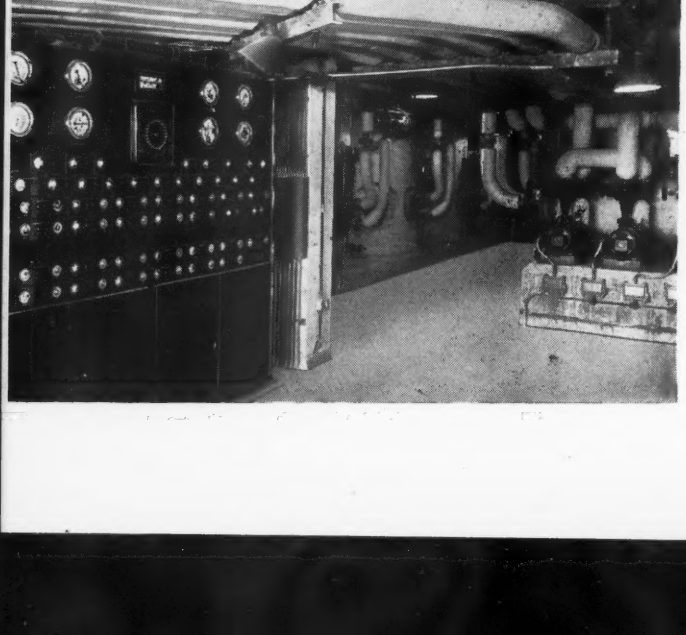
ing reservoirs. Under more severe conditions four additional pumps each of 55 h.p. 1,875 g.p.m. capacity, running at 725 r.p.m. against a 48ft head, come into operation in cascade on the rise of level in the buffer tank.

An extensive fire main system goes to all key points on the aerodrome and will eventually encircle the whole area. Water for fire fighting is obtained from two airfield drainage lakes some way from the airport. A pump house, shown in one of our pictures, also contains an 11 kV substation which represents part of the outer airfield ring. Two step down transformers each for 11/3·3 kV and 1,000 kVA capacity feed seven main pumps each of 325 h.p. 1,500 r.p.m. delivering 1,850 g.p.m. to the two 30in mains going to the airport areas. Normal water pressure is 130 lb/sq in and a 10,000 gal balancer tank is incorporated close to the pump house. For normal slight loss of pressure two 25 h.p. 100 g.p.m. booster pumps cut in on a 2 lb/sq in drop. The seven large pumps operate in cascade on every 2 lb/sq in of pressure drop after this. In the B.O.A.C. and B.E.A. hangar buildings automatic deluge and sprinkler systems are connected to these mains.

Extensive electrical and mechanical services are provided in the new central area. Heating and hot water supplies are from four 10 million B.Th.U. per hour boilers, producing hot water at 365 deg F and 165 lb/sq in. An interesting item on the boiler control panels is a smoke density indicator and recorder, excessive smoke over an airport being clearly undesirable. Duplicate hot water mains are provided, one for space heating, used only in the winter period, and one for hot water and steam generators for cooking purposes. Hot water feeds from the boiler house run down underground tunnels connecting up all the buildings in the central area, in each of which are hot water storage cylinders and calorifiers for the production of low pressure hot water. Control panels by the Rheostatic Co. provide complete visual indication and control of valves and pumps for heating supplies to each part of a building, and one of these in a calorifier room is illustrated. Multi-way temperature indicators are fitted to enable the temperature in all parts of the buildings to be checked. A large amount of ventilating plant, some with provision for air conditioning, is also provided in the central buildings, with similar control panels.

Escalators, lifts, and many belt conveyors for luggage, are installed in the passenger handling building. The luggage conveyors run in three stages, from the coach

Typical calorifier room showing local control panel on left



Apron outlet of baggage conveyor

delivery point to the customs hall, through the hall, and from it to the aircraft apron. Three control panels incorporating two-way telephony with the next point are provided. Start and stop control of the conveyor, and visual indication of the direction of conveyor movement, are given.

A further electrical device in the customs hall consists of a photo-electric cell system at both ends of each luggage conveyor. When switched on these give an alarm and stop the conveyor should any object pass by. This prevents articles not examined by H.M. Customs being slipped on the moving belt for delivery to or from an aircraft. At the time of our visit a much simpler arrangement, consisting of a hinged board dropped over the outlet of the moving belt, seemed to be preferred by the Customs authorities.

We hope to summarize the radar and telephony installations at London Airport in a subsequent article, and in conclusion would like to express our thanks to the Ministry of Civil Aviation and to the airport staff of the chief mechanical and electrical engineer, Air Ministry Directorate General of Works, for their assistance in preparing this account and for permission to describe the equipment they have installed.

English Electric and Atomic Power

THE English Electric Co., Ltd., announces the establishment of a special department to deal with atomic power station development. The company will work in conjunction with Babcock and Wilcox, Ltd., who have played an important part in the design and construction of Calder Hall (Cumberland), the world's first full scale atomic power station, to which English Electric have supplied electrical equipment.

The headquarters of the company's atomic power work is at Whetstone, near Leicester, where the administrative, design, experimental and drawing office staffs are already established. These premises were acquired from the National Gas Turbine Establishment last January. Mr. P. H. W. Wolff has been appointed chief engineer of the atomic power department at Whetstone; he was previously engaged on gas turbine development work for the company at Rugby. He takes charge of a staff, a nucleus of which has undergone special training for development work on atomic power stations. A further increase of staff is to take place by recruitment from both outside and within the company. Dr. H. S. Arms is the chief engineer of the English Electric Co., Rugby, and is responsible for the technical policies of all departments at Rugby and Whetstone.

Electrical Safety

A Survey of Industrial Practice

By F. MURGATROYD,
M.Sc.Tech., M.I.E.E.*

THE broad view of electrical safety is that it has its part in every aspect of electrical engineering. For instance, there are safety considerations in deciding upon the suitability of materials, in the design, testing, layout and protection of plant and in its operation, maintenance and repair. There are certain basic ideas on electrical safety which are applicable to all aspects. In particular, however, we shall consider the application of such ideas to industrial premises to which apply the Electricity (Factories Act) Special Regulations, 1908 and 1944, under the Factories Act, 1937. In this consideration, E.R. will be used to mean an Electricity Regulation, and Ex., an Exemption forming part of the Electricity Regulations.

There is a statutory definition of "danger" in the Electricity Regulations. To avoid danger, it is necessary to avoid electric shock, electric burns and fire caused electrically. Of these three, electric shock claims nearly all the fatalities, though there are many non-fatal burn accidents. The total number of electrical accidents is quite unknown. Those that occur in domestic premises are not recorded unless they are fatal. Nor does the number of 750 electrical accidents occurring in factory premises each year indicate the whole of the risk, because these are "reportable" accidents in which the injured person has been off duty for more than three days. Fatalities, of course, are known and the yearly numbers are about 40 in factories, 40 in domestic premises, and 40 in other places. Remarkably, the total number is about the same each year despite the great yearly increase in the use of electricity. If the total is thought to be low, that is a measure of the good work done by many people and organizations in the establishment of safe conditions. But continued vigilance is necessary because every user of an electrical device supplied at mains voltages or above is "at risk."

Electric Shock Considerations

The severity of an electric shock depends on the value of the current passing through a vital organ of the body and on whether this current is direct or alternating. If the latter, the frequency is a factor. The danger appears to be at a maximum at about 60 c/s: above 50,000 c/s a fatal shock in unlikely. Under similar conditions d.c. is generally considered to be three times safer than a.c. Other factors affecting shock are the duration and the manner of the contact. For a.c. at 50 c/s most people perceive that electrons are active as soon as the current through the body is 1 mA. At 20 mA, there is likely to be loss of muscular control and it would then be impossible for a person to loosen his grip on the handle of a portable drill. It is considered that the lethal zone is entered at about 50 mA (probably a little lower). Higher currents through the heart may cause ventricular fibrillation, which is defined as unco-ordinated beating of the heart muscles, and this condition introduces difficulties. However, medical opinion is that artificial respiration should be successful in most instances of unconsciousness from electric shock, if performed in a skilled manner, started within one minute of the occurrence, and continued without ceasing for whatever time is necessary for resuscitation (certainly up to two hours). Fatal delay can be caused by sending the patient in the works' car to a hospital for treatment.

The method of artificial respiration now gaining favour in this country is the Holger-Nielsen system which has been in use in Scandinavia for many years. It is being taught and used extensively in the U.S.A. Electric shock placards describing and illustrating this method are available for posting in factory premises (as required by E.R. 29) and they may be obtained printed on metal. Another method, called the "rocking stretcher" method, has enthusiastic advocates among medical men because in addition to promoting inspiration and expiration of the lungs, it also promotes blood circulation. The patient is placed on a wide board in the Holger-Nielsen position and this, resting on a trestle, is rocked about 12 times per minute (about 35 deg above and below the horizontal). A satisfactory treatment would be to begin with the Holger-Nielsen method and thus avoid delay. Meanwhile, a rocking stretcher might be erected by other persons and the patient subsequently transferred to it: the rocking stretcher method could then be applied for an indefinite period with little effort.

Lessening the Shock Risk

When electrical apparatus is handled, the risk of electric shock is always a possibility, though it is minimized by good design and by the exercise of reasonable care in its use. But in industrial work, we find that careful use is often absent and some insurance against the risk must then be taken. For portable apparatus it usually takes the form of reduced-voltage a.c. or a change to d.c. For instance, in shipbuilding yards, an expensive and well-protected system of temporary lighting for ships under construction or repair is hardly to be expected and reduced-voltage a.c. or, preferably, d.c. is a requirement to match the reduced protection offered by the somewhat crude lighting arrangements used. For fifteen years, the author has secured the co-operation of shipbuilders in this connection on the Tyne, Wear, Tees, at Barrow and elsewhere. During that period, there has been no fatality due to electric shock from these numerous temporary lighting supplies. Elsewhere in industry, reduced-voltage a.c. circuits are being increasingly adopted for safety, especially for apparatus which has to be handled. For a.c., the reduced voltages commonly provided are: for handlamps, 12, 25 and 50 V; and for portable tools, 50 and 110 V.

Even though the design and installation of apparatus may be excellent, the electric shock risk must be guarded against by correct earthing and by electrical circuit protection. The statutory requirements concerning earthing are contained in E.R. 13 and 21 and Ex. 1. Earthing of metal casings which might be touched is an obligation except for fixed apparatus supplied at not more than 250 V d.c. or 125 V a.c. and for portable apparatus at not more than 150 V d.c. There is no specific exemption for any portable a.c. apparatus, although exemption is, in certain circumstances, obtainable under Ex. 3. In practice, the non-earthing of portable metal-cased apparatus is not objected to if the supply does not exceed 25 V a.c. with respect to earth and the surroundings do not present a severe risk.

* H.M. Electrical Inspector of Factories.

Ideally, the circuit protection should secure the isolation of any defective apparatus which presents a shock risk due to the occurrence of an earth fault from a live part to the earthed casing. In many factories the efficacy of the protection provided is uncertain and it may even be doubtful whether the maximum line-to-earth short-circuit current will be sufficient to operate the circuit fuse or automatic circuit-breaker. To make sure on this point it is necessary to know the impedance of the earth-leakage path back to the neutral of the supplying transformer. If this is R ohms, then the maximum current which can flow will be $\frac{240}{R}$ A where the line-to-neutral voltage is 240 V. Thus, if R is 4 ohms, I max becomes 60 A and fuses calibrated to blow at currents higher than this will not clear the circuit. Most plant managers now realize the importance of knowing this value of R for all factory circuits. An instrument for determining R easily is called a " Loopmeter " or an " Earthometer " and is obtainable from at least three British manufacturers. Its use is shown diagrammatically in Fig. 1. The secondary T2 of the transformer injects a current into the leakage path, and readings of current and voltage enable the impedance to be calculated.

The fault current may be quite small owing to partial breakdown of insulation, and high-resistance faults of this nature may limit the current to some low figure such as one ampere. Probably no fuse blows and the earth-leakage current persists for a time until detected. It impresses a voltage on the apparatus casing, although probably much less than the line-to-earth voltage of 240, and dependent on the ratio of the fault impedance to the earth impedance: finally, complete breakdown usually results. In instances where any such earth-leakage current would create a fire risk, the installation of a reliable type of earth-leakage circuit-breaker becomes essential. The adoption of earth-leakage protection for reasons of shock risk has, however, in the past been limited to instances where excessive values of R cannot easily be reduced. The lower the value of R, as measured by the loopmeter at the factory, the less urgent becomes the provision of earth-leakage protection considered purely as a means of lessening the shock risk. The establishment of earth-free conditions is another method used to counter the danger of electric shock, especially for testing.

The supply to portable apparatus at 415 or 240 V a.c. is, of course, permissible but portability and transportability are so often secured at the cost of rough usage that a change to reduced voltage provides, with a.c., the only real safeguard against the electric shock risk. Preferably, the transformer should be fixed because this avoids the use of a mains voltage flexible cable with earthing conductor, and the possibility that the latter might become disconnected from the earthing pin of the plug and touch the live terminal, thus transferring mains voltage to parts which should be earthed. However, a number of the transformers must be portable and with these it is necessary to keep the mains voltage flexible cable as short as possible and to test frequently for any such disconnection. The transformer metal casing and transformer core should be earthed. Earthing of some point on the secondary winding is a matter for the user's decision. For instance, a 25 V secondary winding may be insulated at all points from earth but, in that event, it is advisable to interpose an earthed shield between the primary and secondary windings. For higher voltages, centre-point or neutral earthing of secondaries is usual and the earthed shield is not then required.

Recently, a man was killed when trying to move a transportable brick conveyor on which there was a small motor supplied at 625 V a.c. The wiring on the conveyor was bad. The earthing conductor was broken and the supplying cable was pierced by a fastening clip. The machine became live at 360 V a.c. above earth. The motor could very well have been supplied at 110 V 3-phase with the neutral point earthed, thus giving a line-to-earth shock of 63·5 V only. The wiring on the conveyor could have been enclosed in conduit and connection could have been through a switch-socket and plug fixed to the frame of the conveyor. Of course, since the fatality, all this has been done.

The record of safety with 110 V a.c. portable apparatus leads to the assurance that voltage reduction coupled with adequate maintenance and testing will secure the desired protection. There are, however, other safety measures occasionally adopted in practical work. One of these is the provision of earth-leakage protection combined with voltage reduction, the circuit arrangement being shown in Fig. 2. The centre point of the 110 V secondary T2 is not earthed direct but through trip coil A. If a fault F occurs inside the tool, current from T2 flows through A and trips the supply via B, which is reset by hand. One criticism is that although another safety device has been added, the portable tool would still work even though the protective circuit became broken or the casing was non-earthed.

Another safety measure is the continuously monitored earthing circuit, shown in Fig. 3 for a 240 V portable tool, although it could be used equally well for other portables, such as transformers. Its object is to protect the user against non-earthing. When tool switch C is closed, current from the secondary T2 of an injection transformer flows through A, closes B and energizes the tool; B cannot be closed by hand. To achieve its object the circuit current must pass through two independent earths. Figs. 1, 2 and 3 are, of course, simplified diagrams.

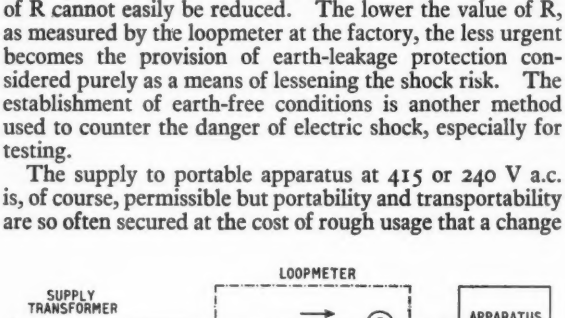


Fig. 1

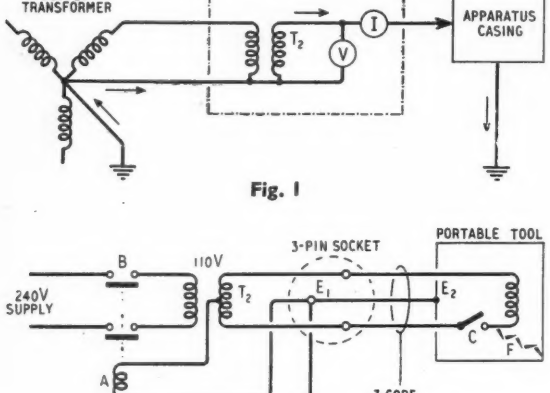


Fig. 2

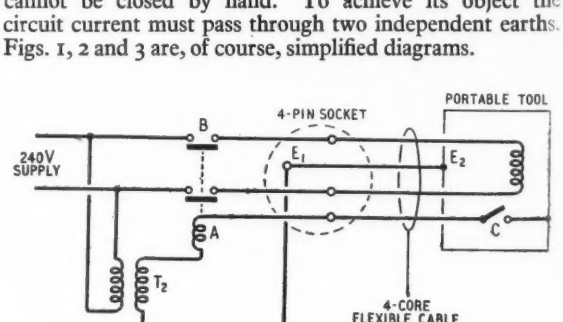


Fig. 3

Permit-to-work certification, as a procedure intended to eliminate shock risk, is a subject of special importance at the present time and is one which cannot be discussed adequately in a short article but it is desired to mention one very essential matter. In the electricity supply industry, permit-to-work certification is an established procedure preparatory to any operation involving possible contact with high-voltage conductors. Where a factory has to operate high-voltage apparatus, this procedure should be adopted also in the factory. The writer has in mind three large factories where this procedure had never been used until very serious high-voltage accidents occurred during 1954. In one of these incidents, a contractor's representative was killed because haphazard arrangements had not been replaced by the strict procedure of a permit-to-work certification system. Needless to say, such a system has since been adopted in all three factories.

Explosive, Inflammable and Dusty Conditions

The requirements of E.R. 27 for explosive atmospheres and inflammable surroundings may necessitate the use of certified flameproof apparatus, intrinsically-safe apparatus, segregation or pressurization. Explosive gases are divided into four groups and certified flameproof apparatus is available for Groups I, II and III. Group II covers most risks in factories other than with town's gas, coke-oven gas and ethylene oxide (which are all Group III) and acetylene, carbon disulphide, hydrogen, blue water gas and ethyl nitrate (which are all Group IV). For Group IV risks, the best procedure is to segregate electrical plant as far as possible and to pressurize the rest. Cables should be enclosed in solid-drawn screwed conduit adequately threaded for full entry into the flameproof fittings. Flameproof conduit boxes should be used. Mineral-insulated copper-sheathed cable is permissible provided that flameproof gland entries to fittings are used. Paper-insulated, lead-sheathed, wire-armoured cable is, of course, suitable for use with a flameproof system and other metal-sheathed cables may be permissible.

The above-mentioned official certification has not been extended to electrical apparatus intended for use in dust clouds which may be explosive. The design used should be effective in preventing any open sparking within the cloud but segregation would be better, if possible. Electrical apparatus which cannot be segregated should be designed to be as dust-excluding as possible. For dust-tight electrical apparatus to be manufactured for Government use, the Department concerned issues a specification with the invitation to tender. Where dusty conditions do not lead to a risk of explosion, it has been found that entry of dust to control-gear enclosures has been successfully avoided by the use of spongy rubber seals at the edges of the covers and, for lighting, double-well-glass fittings have been effective.

Fires from Electrical Causes

There is no doubt that many fires originate from an electrical defect or, more rarely, from electrostatic discharge. The latter must be avoided by leaking the static charge away from the danger zone while the charge is trying to build up and leakage by earthing devices is usually effective. Trials with radioactive isotopes to effect leakage by ionization are being made and such " static eliminators " may be useful where earthing is impossible or unsatisfactory.

Efficient earthing of casings is an essential condition for avoiding the risk of fire. If insulation fails and earth-leakage current flows, it becomes of importance that the earth-path impedance is sufficiently low to permit protective switch and fuse apparatus to function, as mentioned earlier. A plant manager will undoubtedly be concerned about earthing continuity and the condition of conduit. He will also make sure that his fuses and switches are suitable for carrying the load current without overheating and for interrupting the supply when normal overloads occur. It may be overlooked, however, that if the overload is an abnormal one such as the maximum short circuit possible on the system, the gear may fail to clear satisfactorily and fire and explosion may result. The fire risk is greater if such an inadequately-rated switch is an oil circuit-breaker, and the point is therefore specially applicable to high-voltage switchgear. Recently, an 11 kV oil fuse-switch was closed on a feeder cable which had been earthed on all three phases. The fuse-switch was not able to deal with the short-circuit energy and an explosion and oil fire occurred, half the oil being emitted from the switch tank. For seven years since installation, this switch had satisfactorily done its duty of switching and of clearing high-resistance cable faults but this was the first time that it had been called upon to clear the maximum possible short-circuit energy. The man who operated the switch unfortunately died from burns.

Electrical Testing

Testing and research are two of the four processes mentioned in Ex. 4 but a proviso stipulates that danger must be avoided which, among other requirements, involves compliance with E.R. 17, 23 and 24 as regards clearances, insulating stands and protective clothing. An essential condition is that the testing or research should be confined to a place " set apart " and must be done by properly trained people. Enclosure is especially important for high-voltage bare conductors and any access door to the enclosure must have an interlocking arrangement together with means for earthing the conductors before they are handled. Control of test areas is often from a gallery and this position should give an unimpeded view of all the area. In some instances, it may not be possible to move apparatus to the testing enclosure because of weight or size and in that event it is permissible to demarcate a temporary testing area by means of ropes and notices. Watchers should be stationed to keep people out of the temporary area.

In factories, flash testing may be performed in the workroom at an inspection bench, provided that some reasonable demarcation is present, such as side screens at the portion of the bench limited to the testing; and the tester is provided with an insulating stand, rubber gloves and efficient testing prongs with insulating and shielded handles. Earth-free situations are sometimes considered essential under Ex. 4 and one instance is the testing of control switchgear contained in metal cubicles. In use, the metal cubicle would be earthed but because the tester has access to the live metal within the cubicle, earth-free conditions should be created during the test and therefore the casing must be non-earthed.

Crane Trolley Wires

E.R. 2 requires that all live conductors in factories should be safe by position or, if not, they must be insulated and then further efficiently protected where necessary to prevent danger. Most crane trolley wires in factories are not protected by partial enclosure. They are bare and contact with them has on many occasions resulted in serious accident. They must comply with E.R. 2 and the onus is therefore on the occupier to make sure that no person carries out work within reach of the live trolley wires. There must be a safety switch or switches on the crane for the power, lighting and lifting magnet circuits, and down-shop trolley wires must be controlled by labelled

switchgear accessible to any employee from ground level. Means for padlocking switch handles of these isolators in the " off " position should be provided and this method of ensuring safe conditions for work near the trolley wires is better than removal of controlling fuses. Finally, the crane driver must not be in danger from the trolley wires when climbing to the cab or when in the cab and if access to the trolley wires from the crane walkway is possible, it is a contravention of the Regulations not to provide adequate screening.

On floor-operated cranes, there is often an emergency switch which sometimes can be operated only to the " off " position by means of a rope. It is then necessary to climb up and put the switch on again by hand. This has led to dangers from live trolley wires and there has consequently been insistence on two ropes, one to switch " off " and a shorter rope to switch " on " from ground level. Plant managers would be well advised to consider means for using insulated cable instead of bare trolley wires, e.g., for short runs by travelling hoists at despatch bays. Insulated cables fed from cable reeling drums are being used increasingly and they are to be seen in factories for use with travelling cranes.

Safety and Good Design

The above remarks obviously cover only a few aspects of electrical safety applicable to the factory and to the electrical station. If we stand aside and survey the industrial use of electricity, it will surely be considered remarkable that although this use has about doubled during the last ten years and quadrupled during the last twenty years, there has been no corresponding increase in the number of reportable electrical accidents in the electricity supply industry and in the factories of this country. There is, of course, a reason for this and it is to be found in the efforts of many people in establishing electrical safety —safe apparatus and safe methods of using it. It is also a pointer to the high standard of design and manufacture of British electrical apparatus: the best is essential because, in electrical matters it is the safest.

A.S.E.E. Conference

Supervisors' Responsibilities and Salaries

IN the course of his address at the recent annual conference of the Association of Supervising Electrical Engineers, at Bournemouth, Mr. S. H. Harding, A.M.I.E.E., chairman of the Association, said that action was urgently required to remedy the diminution of the differential between the supervisors' remuneration and that of those whose work they supervised. Because of the poor reward for the greatly increased responsibility entailed in the foreman's work men were not anxious to seek promotion. It was now being said that supervisory jobs were literally hawked around the workshops because the best men were not inclined to take extra responsibilities at salaries only a little higher—and sometimes lower—than they were already being paid. It was the duty of those who employed electrical engineers and specialist technicians to see that their remuneration was commensurate with the importance of the work which they performed.

The need to reduce the cost of living in order to give greater purchasing power was stressed by the speaker. The continuing high taxation had resulted in a lowering of living standards generally and the Association's members were among those who so rightly pointed out that since the war any salary increases granted had been completely offset by high costs of living.

The railways, roads, docks and mines were being equipped with new electrical plant; there was to be a gradual change-over to atomic power; and in the cities new schemes were in hand for heating, smoke abolition and improvements in water supplies. All this, together with a healthy export trade, should result in a full demand for the services of the Association's members for a considerable time to come.

The Association had been recognized by the Admiralty and by Merchant Navy organizations who regarded it as the appropriate body to cater for the interests of electrical men seeking employment ashore. Considerable progress had also been made in the Association's projected agreement with the Electrical Contractors' Association of Scotland upon salaries and conditions.

Representatives of the Association were now serving on 31 committees, among them the Institution of Electrical Engineers, British Standards Institution, the Postmaster-General's Advisory Committees and the City and Guilds of London Institute.

Several motions were before the conference, dealing with a wide range of subjects. There was a discussion on the possibility of altering the constitution of the Association to facilitate recruitment, to promote more effective handling of members' interests and to make more clear the differences between the Association's educational and technical work and its trade union activities. It was agreed to proceed with a comprehensive investigation of all facets of the matter. The possibility of creating a National Members' Club in London is to be investigated.

A resolution was carried urging the Minister of Health to take note that the Association was of the opinion that the interests of hospital supervisory electrical engineering personnel were not adequately represented in the National Health Service Whitley Council.

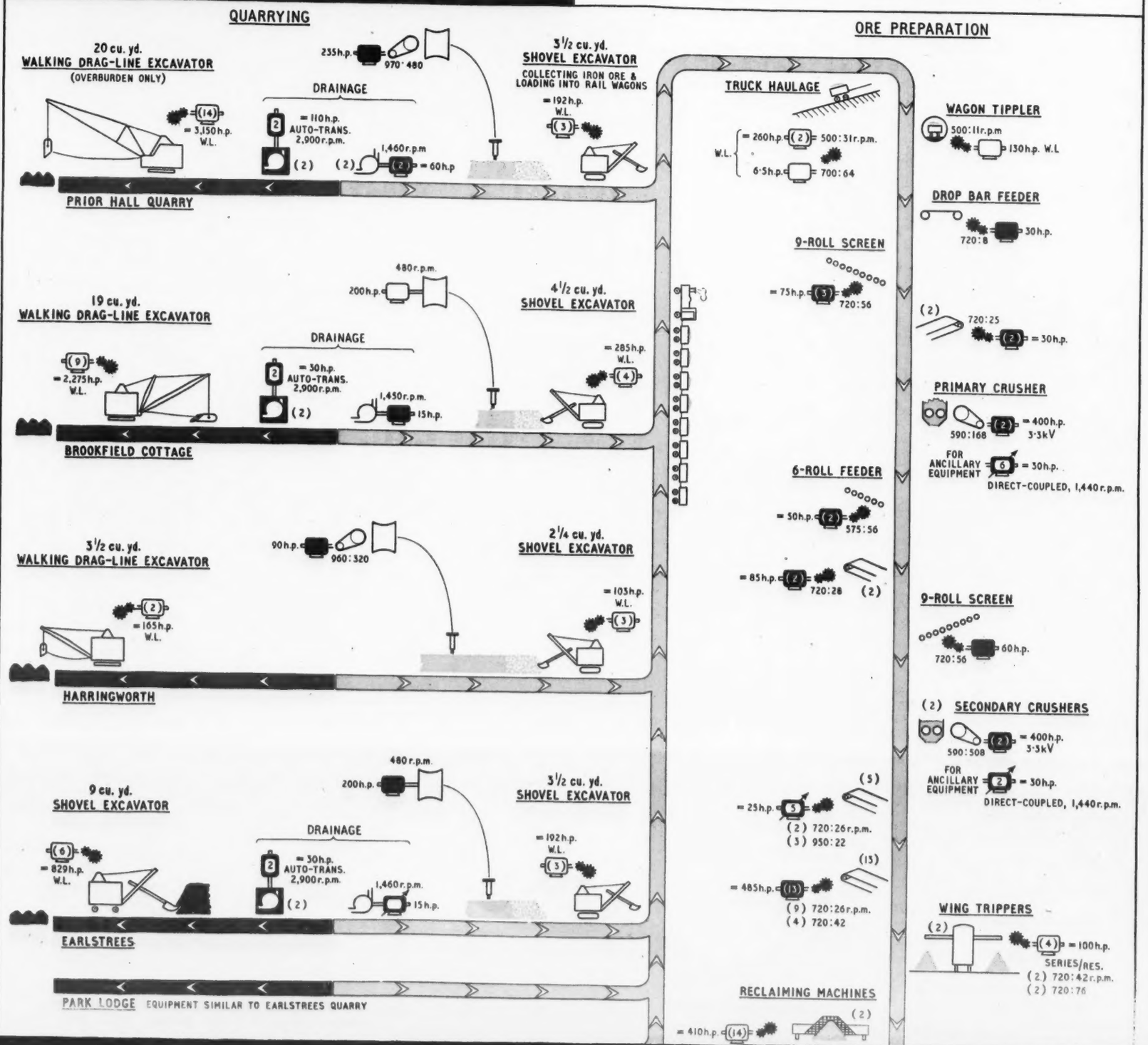
PRODUCTION FLOW LINES

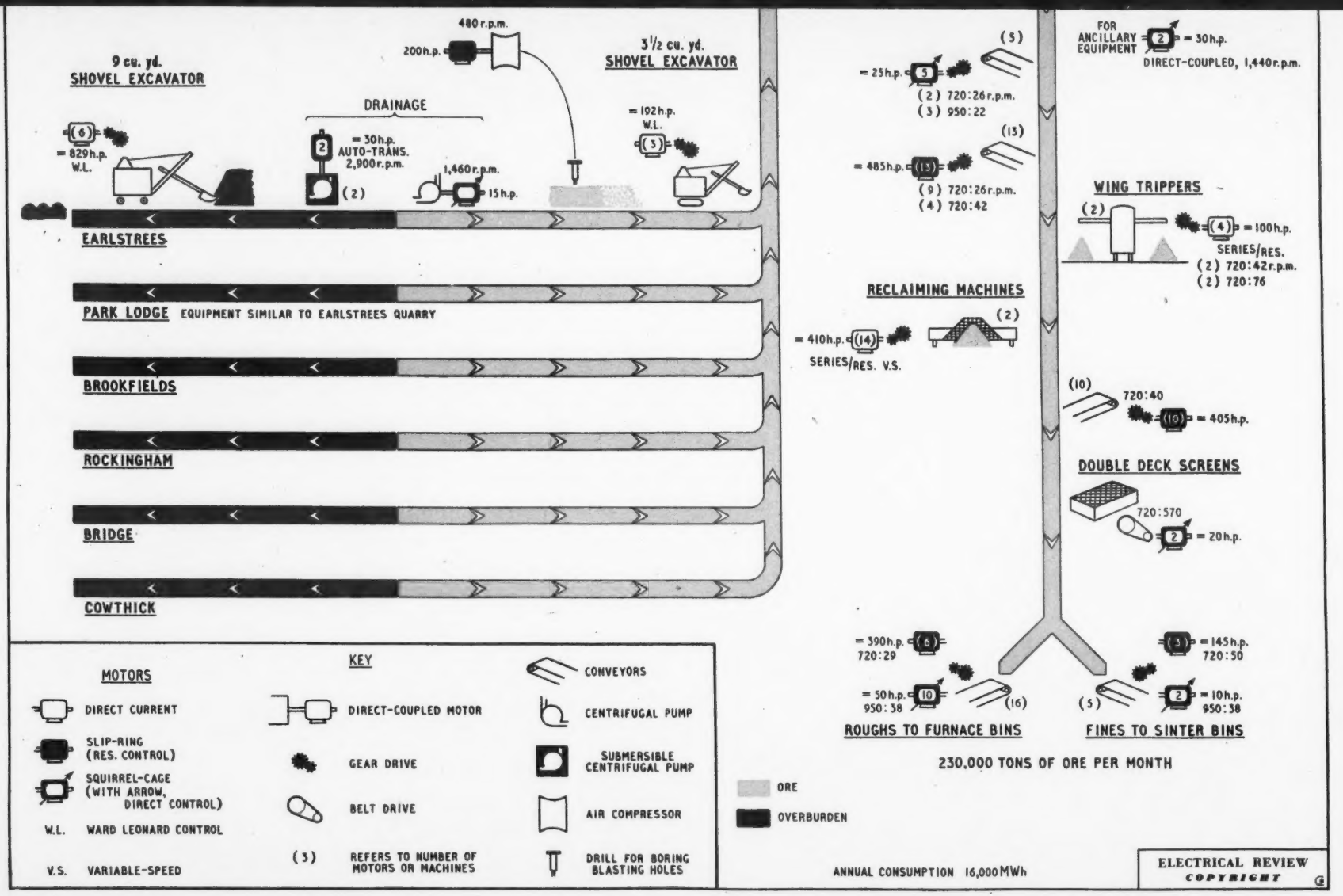
Facing this page is the second of our short series of production flow line charts, this time relating to the operations of overburden removal and ore excavation at the quarry faces, of materials handling and of ore preparation plant. Thus again we deal with one of the basic industries, for the first chart, which was included in our issue of 1st April, dealt with the face, haulage and winding operations at a colliery (Thoresby) chosen at the suggestion of the National Coal Board because of its very high degree of electrification. As in all cases the chart this week is designed to be self-explanatory and of assistance to all those responsible for production and engineering management and, of course, most grades of electrical men by its preparation in the simplest possible manner with the electrical information related to the line. This call for simplicity dictated certain omissions of operations which have only an indirect relationship to the flow line proper.

ELECTRICAL REVIEW

PRODUCTION FLOW LINE CHART No. 2

At the Corby quarries and ore preparation plant of Stewarts & Lloyds, Ltd., Corby, Northants, the flow line embraces a total of 18,125 h.p. of electric motors for an output of 230,000 tons of ore per month on an ore winning basis of 56 hours per week.




9 cu. yd.
SHOVEL EXCAVATOR
480 r.p.m.
200 h.p.
3½ cu. yd.
SHOVEL EXCAVATOR
DRAINAGE
(6)
= 829 h.p.
W.L.
2
= 30 h.p.
AUTO-TRANS.
2,900 r.p.m.
(2)
1,460 r.p.m.
15 h.p.
= 192 h.p.
W.L.
(3)
EARLSTREES
PARK LODGE
EQUIPMENT SIMILAR TO EARLSTREES QUARRY
BROOKFIELDS
ROCKINGHAM
BRIDGE
COWTHICK
(5)
= 25 h.p.
5
(2) 720:26 r.p.m.
(3) 950:22
(13)
= 485 h.p.
13
(9) 720:26 r.p.m.
(4) 720:42
RECLAIMING MACHINES
(2)
= 410 h.p.
(14)
SERIES/RES. V.S.
FOR
ANCILLARY
EQUIPMENT
2
= 30 h.p.
DIRECT-COUPLED, 1,440 r.p.m.
WING TRIPPERS
(2)
(4)
= 100 h.p.
SERIES/RES.
(2) 720:42 r.p.m.
(2) 720:76
(10)
720:40
(10)
= 405 h.p.
DOUBLE DECK SCREENS
720:570
2
= 20 h.p.
= 390 h.p.
720:29
6
= 50 h.p.
950:38
10
(16)
ROUGHS TO FURNACE BINS
3
= 145 h.p.
720:50
(5)
2
= 10 h.p.
950:38
FINES TO SINTER BINS
230,000 TONS OF ORE PER MONTH
ORE
OVERBURDEN
ANNUAL CONSUMPTION 16,000 MWh
ELECTRICAL REVIEW
COPYRIGHT
KEY
MOTORS
DIRECT CURRENT
SLIP-RING
(RES. CONTROL)
SQUIRREL-CAGE
(WITH ARROW,
DIRECT CONTROL)
W.L. WARD LEONARD CONTROL
V.S. VARIABLE-SPEED
DIRECT-COUPLED MOTOR
GEAR DRIVE
BELT DRIVE
(3) REFERS TO NUMBER OF
MOTORS OR MACHINES
CONVEYORS
CENTRIFUGAL PUMP
SUBMERSIBLE
CENTRIFUGAL PUMP
AIR COMPRESSOR
DRILL FOR BORING
BLASTING HOLES

VIEWS on the NEWS

By REFLECTOR

WITH what a glow of satisfaction one sees a necessity become a virtue! Mutual felicitations were the order of the day at Hamworthy (Dorset) recently when the Mayor of Poole planted a commemorative tree on the first 5½ acres of grassland reclaimed from Poole Harbour by the deposition of ash from the Poole generating station. In 1950 the Poole Corporation purchased over 80 acres of low-lying land at Turlin Moor with a view to converting it into playing fields. Since that time over a quarter of a million tons of ash has been deposited in a 12ft thick layer, covered with soil and sown with grass. Another 6½ acres will be ready for use in a short time. Speaking on behalf of the Central Electricity Authority, Mr. R. H. Coates, controller of the Southern Division, said that the Corporation had obtained playing fields for their people at a modest price and the C.E.A. had been able to dispose of their ash at a lower cost than by any of the alternative methods available.

* * *

Last week's leading article stressed the importance of filling in the load-curve valleys by encouraging off-peak loads. I would not suggest that the Central Electricity Authority should enter the boxing promotion "industry" but it is a fact that the recent Marciano-Cockell fight an account of which was broadcast in the early hours raised the national electricity demand by 600,000 kW. This was about 13 per cent above the normal level. This apparently includes the South of Scotland where there was a rise of 40,000 kW in the load during the hour of the broadcast.

* * *

At a meeting of the Swineshead Parish Council there was criticism of the Boston R.D.C. on several counts. One member is reported by the *Lincolnshire Standard* to have raised the case of a Council house tenant who had trouble with her electric cooker. Tenants had been told that they must report any complaints about their electrical equipment to the R.D.C.—not to the Electricity Board. This particular tenant reported her trouble to the R.D.C. and not hearing anything for a fortnight telephoned the Council office and was told by "a voice on the other end of the phone" that she should put a fire under the cooker. Instead of doing this she acquired an oil stove—a very unsatisfactory substitute. It seems to me that better service would be obtained if tenants were allowed to deal directly with the Electricity Board.

* * *

Consumers who were lucky enough to enter a simple hire scheme before the war are becoming a burden to some of the Electricity Boards. Their appliances are largely obsolete and need an increasing amount of attention. Probably because they have not wanted to lose the consumers' goodwill the Boards have continued their existing hire agreements and, as generally simple hire is not now indulged in, they have not considered it wise to replace the appliances and have gone to great lengths to keep them in service. This could not go on for ever and as I mentioned a week or two ago the South Eastern Board has decided to terminate agreements in respect of several classes of obsolete equipment, allowing the consumers to keep the appliances if they want to. I predict a rise in hire-purchase sales.

* * *

At a recent conference of delegates from New South Wales electricity undertakings held in Sydney the subject under discussion was safety. Reference was made to recent accidents and the conference stressed the importance of proper earthing. A correspondent tells me that while the discussion was being recorded on the tape machine the operator received a shock and it was found that the machine had not been earthed at all. There seems to be a moral in this.

* * *

Methods of testing structures by the use of "ultrasonics" were described in a recent article in the *Birmingham Mail*. The heading was "Inaudible sounds can tell a story."

At what frequency does an inaudible sound become an invisible sight?

* * *

Some extremely rude things were said about the Press at the recent Electrical Trades Union Conference at Worthing. Although I do not think that the remarks were directed at the technical Press I feel some sympathy with the president of the Institute of Journalists when he says:—

> "The flinging of abuse at an honourable and conscientious body of men will be fiercely resented by all workers in journalism, professional and trade unionist, who value the British tradition of liberty of opinion."

* * *

In last week's issue of this journal there was a description of a man-carrying centrifuge installed at Farnborough to enable the effects of high-speed turns upon aircraft pilots to be determined. By a coincidence I have discovered in the *Electrical Review* of 30th May, 1885 (seventy years ago) the story of the somewhat similar experience of a cat. At the Brooklyn Municipal Electric Light Company's station, New York, the engine had a large flywheel running in a pit.

> "When the engine was started one night a cat, which made its home in the station, was on one of the spokes in the pit, out of sight of the engineer. The wheel was soon making 20 revolutions a minute. It was impossible to rescue the cat from its perilous position without stopping the engine, and that would break every circuit and put out all the lights dependent upon the dynamos in the station; so the unfortunate animal had to ride on until the engine was stopped at the usual hour for putting out the lights. The cat then dropped exhausted from the wheel, but soon revived and was none the worse. It is estimated that the animal travelled 300 miles on the wheel."

OVERSEAS ELECTRICAL TRADE

Advance During April

POSSIBLY on account of the Easter period falling this year both in March and April (Good Friday was on 30th March) the April electrical export figures were substantially higher than those for the corresponding month of last year. The Board of Trade return for April gives the total value of exports of "electric machinery, apparatus and appliances" as £16,821,080 against £14,074,867 for April, 1954. This raised the total for the first four months of the year to £64,940,081, a figure which compares very favourably with the 1954 total of £59,434,199 (see Table I).

So far as the April figures are concerned the increase as compared with April, 1954, appears to have been largely due to an advance in shipments of cables from £1,482,950 to £2,247,038. All classes contributed but the biggest rise occurred in the case of telegraph and telephone cables. Cooking appliance exports were generally higher but space- and water-heating equipment (except for parts) recorded lower figures. Among other domestic appliances exports of irons were greater but those of vacuum cleaners, floor polishers, etc., fell.

Equipment for aircraft and motor vehicles made a good advance but meters and instruments were lower in value. Upon the whole exports of telegraph and telephone equipment and radio apparatus were higher.

The machinery class was greater in total largely because

TABLE I.—ELECTRICAL EXPORTS

Class	April, 1955	Four months ended 30th April, 1954	Four months ended 30th April, 1955
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	116,000	390,881	523,258
Ditto, 10 to 65 kW	157,326	506,272	558,905
Ditto, 65 to 200 kW	214,095	251,388	447,431
Ditto, over 200 kW	311,916	1,319,719	2,016,696
Spark ignition engine driven	28,995	82,284	99,904
Steam turbine driven	164,925	320,834	581,541
Other prime mover driven	48,413	191,261	320,746
Generators	368,476	990,731	1,115,149
Parts of generators	399,721	1,732,938	2,074,906
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ¼ h.p.	269,077	707,629	951,303
Over ¼ but under 1 h.p.	76,359	181,150	281,513
1 h.p. to 250 h.p.	364,319	1,622,959	1,560,236
Over 250 h.p.	68,142	594,899	340,293
Railway, tramway and trolley-bus motors complete and parts of all motors	157,398	639,916	560,091
Motor starting and controlling gear	200,936	871,833	826,721
	2,946,098	10,404,694	12,258,693
Converting machinery	41,803	119,568	212,569
Mercury-arc rectifiers	80,370	188,143	273,630
Transformers for lighting, heating and power (incl. coils)	1,083,754	4,251,084	3,861,138
Switchgear and switchboards (not telegraph or telephone)	1,426,487	5,410,695	5,538,457
	2,632,414	9,969,490	9,885,794
Primary batteries:			
Lighting	86,325	271,016	296,224
Radio	178,991	580,373	668,496
Other	38,483	187,325	161,036
Parts (excl. carbons)	41,907	240,067	131,194
Lamps:			
Filament, exceeding 24 V	102,877	286,644	387,982
Ditto, under 24 V	36,897	118,785	128,139
Discharge lamps, fluorescent tubes, etc.	69,716	242,440	288,880
Other lamps	8,585	139,522	56,516
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilizing and cold cathode valves, magnetrons, klystrons	21,213	—	109,328
Cathode-ray tubes	11,256	34,910	39,484
Other valves (not X-ray)	136,257	656,678	692,351
Radio and television transmitters	90,875	241,652	228,182
Commercial radio and radar equipment	1,264,052	3,991,859	3,996,247
Domestic radio receivers, mains	172,347	610,595	722,382
Ditto, battery	69,253	210,060	256,362
Ditto, other (incl. car)	35,970	39,668	87,118
Radiograms	51,624	140,474	208,871
Television sets	13,485	65,196	35,550
Public address equipment	91,874	239,785	307,269
Sound reproducing app., n.e.s.	32,950	63,643	101,785
Components and parts, n.e.s., incl. parts of valves and c.r. tubes	609,850	2,211,917	2,358,043
	2,601,006	8,506,437	9,142,972
Telegraph and telephone installations	723,152	2,499,669	2,992,164
Telephone instruments, separately consigned	93,265	467,641	295,563
Telegraph and telephone parts	592,969	1,821,703	1,981,027
Line apparatus for long distance commun.	90,576	708,623	331,764
	1,499,962	5,497,636	5,600,518

Class	April, 1955	Four months ended 30th April, 1954	Four months ended 30th April, 1955
	£	£	£
Cookers	131,849	239,910	635,467
Toasters	41,501	66,813	124,119
Other cooking apparatus	29,451	105,044	132,907
Parts and accessories	69,940	148,087	259,272
Space heating appliances	41,054	151,035	183,504
Water heating appliances	29,610	111,837	123,911
Other heating appliances	32,457	150,333	131,868
Parts and accessories	72,802	173,116	268,321
Irons	119,153	253,966	453,250
Arc welding equipment, a.c.	25,382	169,186	140,152
Ditto, d.c.	48,891	186,809	136,928
Resistance welding equipment	40,230	43,109	99,724
Electric furnace plant	37,180	—	162,259
Magnetos, ignition	13,768	60,787	64,222
Sparking plugs	172,713	592,843	633,097
Elec. appliances for aeroplanes, n.e.s.	261,666	882,301	794,043
Ditto, for motor vehicles, n.e.s.	302,940	950,545	1,190,183
Ditto, for cycles, n.e.s.	74,522	339,285	308,914
Signalling app. (incl. traffic signals)	56,594	244,919	183,886
Industrial radio-frequency equipment	13,888	91,384	60,410
Bell app. (not telegraphic or telephonic)	7,675	34,193	34,874
Instruments, commercial	129,714	595,344	596,166
House service meters (not prepayment)	99,631	460,909	430,065
Ditto, prepayment	16,279	76,931	85,504
Electro-medical apparatus (not X-ray)	39,096	180,728	176,837
X-ray apparatus (excl. tubes and valves)	63,105	179,611	232,876
Vacuum tubes	15,404	79,268	93,298
Desk fans	33,954	126,884	98,100
Ceiling fans	101,891	388,778	403,214
Parts of fans	—	—	30,529
Vacuum cleaners	133,952	771,091	583,885
Floor polishers	98,134	451,683	346,954
Food mixers	51,000	190,388	193,361
Hair clippers and dry shavers	44,724	316,304	318,512
Other portable appliances	41,001	108,532	215,260
Parts	80,233	293,286	290,655
Portable elec. tools (not saws) and parts	198,152	603,194	773,595
Cables and wires:			
Telegraph and telephone, submarine	121,395	244,570	446,908
Ditto, other	585,366	1,578,634	1,972,349
Cotton, silk or art. silk insulated	43,062	163,402	198,181
Enamel, glass or asbestos insulated	88,584	273,099	324,317
Paper insulated	611,400	2,449,244	2,575,388
Rubber insulated	503,062	1,555,731	2,009,839
Thermoplastic insulated	87,838	—	286,487
Other	206,331	908,823	743,069
	2,247,038	7,173,503	8,556,538
Accumulators for motor vehicles	150,509	648,579	595,944
Ditto, traction	15,162	101,858	63,514
Ditto, radio and other portable	40,777	132,091	231,705
Ditto, other	26,364	255,052	94,308
Parts and accessories	81,979	253,873	366,966
Elec. porcelain, etc. (incl. insulators)	80,195	353,245	362,287
Insulating cloth and tape	54,227	175,430	254,879
Other insulating material	100,653	311,685	381,269
Permanent magnets	49,821	154,559	193,993
Radio, telegraph and telephone testing equipment, n.e.s.	31,511	153,796	159,594
Scientific elec. instruments (not telegraphic or telephonic)	230,712	764,270	1,010,717
Electrical machinery, n.e.s.	63,434	498,013	320,231
Electrical apparatus and appliances, n.e.s.	630,045	2,195,383	2,351,570
TOTAL	16,821,080	59,434,199	64,940,081

TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

Country	April, 1955	Four months ended 30th April, 1954	Four months ended 30th April, 1955
	£	£	£
Channel Islands	50,875	204,403	207,936
Gibraltar	10,780	32,815	107,725
Malta and Gozo	48,495	238,386	248,245
Cyprus	75,260	292,312	398,392
Sierra Leone	20,034	52,773	126,144
Gold Coast	109,454	379,508	510,906
Nigeria	392,928	612,976	1,016,874
Union of South Africa	2,238,821	6,523,024	6,966,882
Rhodesia and Nyasaland	469,827	1,282,636	1,606,471
Tanganyika	108,202	200,478	325,699
Kenya	149,148	666,711	601,982
Uganda	134,479	330,226	387,447
Mauritius	25,901	119,234	131,380
Aden	59,398	444,215	221,196
Bahrain, Qatar and Trucial Oman	83,250	501,584	304,580
Kuwait	63,412	636,843	369,515
India	1,227,980	5,296,877	5,509,668
Pakistan	241,141	2,126,748	1,280,597
Singapore	390,078	1,156,191	1,404,422
Federation of Malaya	251,116	931,683	1,007,095
Ceylon	120,032	493,323	463,489
British North Borneo	23,924	132,135	111,269
Hong Kong	129,589	715,801	655,161
Australia	1,844,994	5,737,858	7,004,834
New Zealand	962,521	3,206,050	4,873,657
Canada	712,870	2,033,713	2,382,862
Jamaica	79,453	270,211	297,739
Barbados	15,565	56,999	76,842
Trinidad	77,484	326,277	375,227
British Guiana	57,336	172,238	199,165
Anglo-Egyptian Sudan	71,164	382,260	403,501
Other Commonwealth countries	172,427	477,691	706,837
Irish Republic	275,652	1,080,841	1,276,000
Soviet Union	127,830	981,316	693,516
Finland	85,635	405,331	414,530
Sweden	366,111	1,370,554	1,338,477
Norway	234,181	1,010,867	1,274,469
Iceland	3,723	55,876	45,179
Denmark	164,198	784,324	532,619
Poland	4,081	373,502	88,831
Western Germany	98,353	415,159	584,920
Netherlands	728,632	2,232,086	2,266,664
Belgium	179,314	1,130,650	875,992
France	296,501	1,274,552	981,100
Switzerland	67,301	321,260	284,101
Portugal	161,871	1,051,990	1,007,575
Spain	73,008	984,711	466,092
Italy	182,726	967,857	773,497
Austria	20,345	302,772	113,742
Yugoslavia	174,708	518,025	333,424
Greece	154,646	287,518	581,109
Roumania	—	1,662	614
Turkey	116,084	263,642	400,683
Belgian Congo	18,393	108,628	143,960
French Morocco	36,483	89,062	128,979
Portuguese East Africa	21,835	104,078	77,749
Syria	36,622	99,290	126,853
Lebanon	35,796	112,902	124,744
Israel	37,832	166,227	153,589
Jordan	33,791	95,815	122,140
Egypt	81,209	406,891	494,220
Libya	20,325	36,261	64,059
Saudi Arabia	83,959	214,355	305,759
Iraq	323,569	837,333	956,572
Iran	103,585	119,640	267,025
Burma	130,821	531,284	715,918
Thailand	51,414	343,611	612,901
Indonesia	10,216	183,482	97,534
Japan	77,983	192,833	316,557
United States of America	647,889	1,038,189	1,476,576
Cuba	27,047	92,777	105,710
Mexico	22,350	82,579	109,621
Colombia	59,403	234,916	397,598
Venezuela	415,945	563,812	1,219,859
Peru	46,806	100,790	161,064
Chile	12,957	122,014	182,757
Brazil	27,356	356,697	175,463
Uruguay	28,396	289,945	147,506
Argentine Republic	185,088	389,670	682,185
Other foreign countries	310,372	672,444	1,056,310
TOTAL	16,821,080	59,434,199	64,940,081

of improved export of generators and generating sets and fractional h.p. motors.

Among the classes of goods shown in the return outside the electrical division are the following; the April export figures are given with the corresponding figures for April last year in parentheses:—Electrically-operated washing machines, £476,217 (£470,852); electric locomotives, £215,846 (£25,796); and i.c. engine locomotives with electrical transmission, £434,278 (£81,389). It will be seen that the last two items made great headway.

The analysis in Table II shows that South Africa was our principal customer in April with a total of £2,238,821 (against £1,928,940 in April last year). The Union thus regained the first place which was taken by Australia in March last. Australia's share of the trade increased by a greater proportion—from £1,419,738 to £1,844,994—reflecting, no doubt, the easing of the restrictions, which have since been tightened again. India remained in the second place with a rise from £1,143,244 to £1,227,980. More was sent to Canada, the total rising from £499,316 to £712,870. A noteworthy item is the increase in exports to Uganda from £23,546 to £134,479, possibly in connection with the Owen Falls scheme.

The Irish Republic kept well up with an increase from £253,246 to £275,652 and Russia's share jumped from £59,222 to £127,830, although for the first four months of the year her total was £693,516 against £981,316 for January-April, 1954.

Among the other foreign countries, the Netherlands occupied first place with a share increased from £617,226 to £728,632. Particularly gratifying was an expansion in the United States figure from £204,945 to £647,889. Other outstanding increases occurred in the cases of Venezuela, from £124,242 to £415,945; Iraq, from £168,586 to £323,569; and Argentina, from £91,641 to £185,088.

Electrical imports were again much higher in April (at £1,766,196), raising the total for the first four months of the year from £4,823,369 to £6,438,941. A fall in imports from Canada to £94,275 was more than balanced by greater purchases from Western Germany (£267,421), the Netherlands (£469,406) and the United States (£433,462). The bulk of the imports fell into the telegraph, telephone, radio, etc., class.

Non-Ferrous Metals Research

THE 35th annual report of the British Non-Ferrous Metals Research Association shows that the Association's expenditure during 1954 reached a record of £132,000, of which two-thirds was spent on research and the remainder on the Liaison and Information Departments. These two Departments, although jointly responsible for so much less of the overall expenditure than the researches, serve an extremely important function in feeding information and providing "know-how" for members who want assistance. The Information Department brings published information to members' notice, and is extremely expert in turning up quickly existing recorded information on a wide variety of subjects. The Library lends large numbers of books, journals and papers through the post.

The Liaison Department on the other hand is more concerned with "know-how" and with putting existing knowledge to specific practical applications. It can be consulted in confidence on any problem, and in addition to giving advice on current difficulties it also offers assistance in applying research results to industrial practice. It visits members' works, examines production methods, and suggests or tries out new methods designed to improve products or processes.

The Research Department last year had in hand 39 major researches, covering the extraction, manufacture and properties of the main products of this extensive industry. The bulk of the work deals with the more widely used industrial metals, but some is concerned with special materials like titanium and zirconium; some with methods of inspection and control; a substantial group with methods of finishing, particularly electroplating; and a number with fundamental properties of metals and alloys, knowledge of which might have wider repercussions.

Scientific Research in India

THE Thomas Holland Memorial Lecture was delivered on 19th May at the Royal Society of Arts by Sir Alfred Egerton, who gave an account of the position of scientific research in India as observed during two recent visits there as chairman of the committee which reviewed the work of the (Indian) Council of Scientific and Industrial Research. A Government five-year plan (initiated in April, 1951) for raising the standard of living of the 360 million inhabitants (only 10 per cent of whom lived in large towns) aimed at a rapidly increased agricultural production and a substantial industrial expansion. Only 1·8 per cent of the labour force, he stated, was employed in factories from which only 6·5 per cent of the national income was derived.

The plan envisaged spending 561 crores of rupees (27 per cent of the total allocated) on increasing the area under irrigation from 50 million to 76 million acres and on more than doubling the hydro-power to 3·2 million kW, mainly through private enterprise in the preliminary stages. Only a small fraction of the 2·5 per cent of the total included in the term "miscellaneous" had been set aside for research, but the amount was to be increased. The Ministry of National Resources and Scientific Research was set up in 1951 and the late Dr. Shanti Bhatnagar, F.R.S. (who died early this year) was appointed as secretary. He had been the driving force as director of previous Government research organizations from 1940 onwards.

There were 29 universities in India. From the account given of visits to twelve laboratories covering various industries, the following points have been taken. The direct use of solar radiation (with a theoretical potentiality of 1,000 million h.p.) appeared to offer most scope in providing energy for cooling large buildings, in which connection physiological factors were also being studied. The Indian Institute of Science at Bangalore could well be developed as a higher technological college on the lines of the Massachusetts Institute or the Imperial College, London. The total iron and steel production of India was about one million tons yearly, while the total requirement was three million; plants are being erected with an output of six million tons. The annual coal production was 35 million tons, of which 10 million went to the railways and $4\frac{1}{2}$ million to provide coke for metallurgical industries; about one million tons was exported.

The need for excellence in one particular field of study that appeared most worth while was emphasized. The value of research was illustrated by one large firm in the U.S.A., which was said to spend yearly 2·8 per cent of its gross income on scientific research and to take out one patent daily; it was expected that, by 1970, 60 per cent of the gross income would come from products at present unknown or on which research had hardly begun.

A Board of Engineering Research was established in 1950 as an advisory body to the C.S.I.R. for the purpose of initiating, guiding and financing research. Most industrial concerns were as yet too small to maintain research departments of their own and needed to realize the advantages of forming co-operative research associations. Difficulty had been found in attracting young men to spend years in research to the possible detriment of their engineering careers with regard to salaries and other opportunities. Facilities for research in the C.S.I.R. laboratories and in the Bangalore Institute were good.

Consulting Engineers' Report

THE report of the Council of the Association of Consulting Engineers for the year ended 30th April was issued last week. Thirty-seven new members joined the Association during the year making a total of 403 (effective members, 395; non-practising members, 8).

The Committee for General Conditions of Contract met during the year to consider amendments to various clauses in the third edition (March, 1951) of the general conditions of contract in connection with works of civil engineering construction suggested by the Institution of Civil Engineers, the Federation of Civil Engineering Contractors and the Association. Various amendments were accepted and a revised edition (fourth) dated January, 1955, has now been issued. The Joint Committee do not propose to issue a further edition for five years unless exceptional circumstances render such action necessary.

In last year's report it was stated that the question of producing special conditions of contract for work overseas was being re-examined. This is a most difficult matter owing to the differing conditions of many kinds which occur in countries overseas, and though discussions have taken place between representatives of the Association and the Export Group for the Constructional Industries and a preliminary draft has been prepared, some time is likely to elapse before an agreed draft is available.

The agreement reached with the Export Group for the Constructional Industries for work abroad has been communicated by the Board of Trade to Commercial Secretaries and Trade Commissioners abroad. It is pointed out that the existing method of working between consulting engineers, clients and contractors is to be preferred and will continue except where a prospective client requires an "all-in tender." In that case the contractor will put forward a comprehensive offer. There will be full consultation between the consulting engineer and the contractor in the preparation of the design to meet the requirements of the client, and its adequacy is safeguarded under the terms of the agreement.

The report says that consulting work abroad is likely to increase in the near future and the more work consulting engineers can be given at home the better position they will be in to increase overseas trade and help the country's economic position. It is thought that if engineering staffs of Government Departments, and certain nationalized industries were retained at a level sufficient only for normal and day-to-day work whilst design and supervision for new works was transferred to consulting engineers, considerable advantage would accrue.

During the year the Board of Trade set up an Advisory Council on constructional work abroad under the chairmanship of the Minister of State with representatives of the Association, the Export Group for the Constructional Industries, the manufacturers and Government Departments as required.

New G.E.C. Midlands Headquarters

ON 17th May the Lord Mayor of Birmingham, Alderman J. R. Balmer, opened Magnet House, Newhall Street, Birmingham, the new headquarters of the sales organization of the General Electric Co., Ltd., in the Midlands. The opening ceremony was attended by Mr. Leslie Gamage, vice-chairman and joint managing director, and many friends of the G.E.C. in the area. The company's first Birmingham sales branch was opened in Corporation Street in 1894 and it has since occupied progressively larger establishments in Barwick Street, High Street and Moor Street. Since December, 1940, when the original Moor Street offices and showrooms were destroyed by enemy action, the Birmingham branch has occupied temporary accommodation in Moor Street and Freeman Street.

The new Magnet House, which occupies a square one-acre site at the intersection of Newhall Street and Charlotte Street, consists of two 4-storey wings enclosing a single-storey storage area. The majority of the offices are accommodated in the Newhall Street wing. Altogether 49,000 sq ft is devoted to counter service and stockrooms, 28,000 sq ft to offices and 6,000 sq ft to showrooms and demonstration areas.

The circular entrance hall, flanked by open cases displaying a selection from the company's products, is lit by recessed tungsten fittings and cold cathode fluorescent tubes in a ceiling cornice. An annexe on the right of the hall houses a television and radio demonstration room, beyond which is the large general office of the branch; a corresponding annexe on the left of the hall is devoted to special displays, and beyond this annexe is the trade counter. A passenger lift from the hall serves every floor in the building.

The new sales headquarters of the G.E.C. at Magnet House, Newhall Street, Birmingham

Stairs from the entrance hall lead down to showrooms which it is claimed are the largest and most comprehensive in the Midlands for the display of electrical equipment for the home. Recessed alcoves in the lighting rooms allow for the display of a few fittings in settings suggestive of typical room interiors. The other two showrooms are devoted to industrial fittings and electrical household appliances. An important feature of the showroom area is the provision of a proscenium and curtain so that it can if necessary be converted into a theatre for demonstrations, lectures or films.

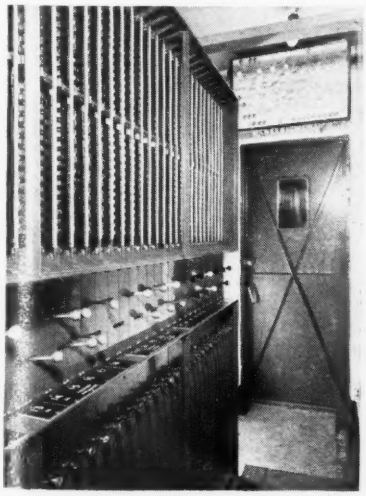
On the third floor is a demonstration kitchen. This floor also accommodates a restaurant for the staff.

A separate entrance in Charlotte Street for the trade leads to a small hall with the trade counter to the right and the service counter to the left.

Special attention has been given to lighting throughout the building. The main entrance is indicated by a 4ft 6in "Claudgen" illuminated sign mounted at the top storey level, while above the entrance canopy the full name of the company in cut-out letters is silhouetted at night by two lines of cold cathode tubing. The entrance is further illuminated by 500 W tungsten floodlights concealed in the canopy. The yard of the building is lit at night by 1 kW mercury floodlights mounted at roof height so that they can be swung back for servicing on the roof itself. Fluorescent lighting has been adopted throughout the offices, stores and corridors, a mile of fluorescent tubes being employed altogether.

Aldersgate Signalling Installation

RENEWAL of the signalling equipment in the vicinity of Aldersgate on the Circle Line has been carried out by London Transport, utilizing remote control equipment of a new type. The operation of power-worked signal levers by remote control was first carried out at Shoreditch in 1944, and when the Ealing Broadway signalling was renewed in 1952 there was a further development, the remote controlled equipment being adapted to control from a push-button control desk. In the new Aldersgate installation the development has been carried a stage further. The lever frame has now been dispensed with and a new "interlocking machine," controlled by push-buttons from the signal box at Farringdon, has been designed to take its place.



Interlocking machine in Aldersgate station

The interlocking machine is of a simple vertical design with 36 upright shafts, each operating one signal or point function. Provision is made for mechanical interlocking between the shafts. At the base of each shaft two small compressed air cylinders supply the rotational movement. Immediately above the compressed air cylinders is the mechanical locking. Above this an electrical lock provides the back locking and track locking and at the top of the machine are a set of contacts for controlling the signal and point circuits. The Aldersgate interlocking machine operates 20 signals and 14 sets of points and it is controlled by a small auxiliary push-button panel in the Farringdon signal box, comprising 23 pushes for 19 routes. The machine was designed in the Signal Department of London Transport, detailed designing having been done for the Executive by the Westinghouse Brake & Signal Co.

Following the Aldersgate installation, it has been decided to provide three interlocking machines in connection with resignalling at Camden Town (Northern Line) during this year, and the system is likely to be extensively employed elsewhere.

Aluminium Exhibition

To mark the centenary of the introduction of aluminium the Aluminium Development Association has organized a non-commercial exhibition at the Royal Festival Hall, London, S.E.1, from 1st to 10th June. It will illustrate the use of aluminium in many industrial fields and on certain days there will be discussions on particular branches. The first, on 1st June, will be devoted to aluminium in electrical engineering.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

At the annual general meeting of the Institute of Physics held on 17th May **Sir John Cockcroft** (director of the Atomic Energy Research Establishment, Harwell) was re-elected president. **Dr. W. H. Taylor** was elected a vice-president, **Dr. S. Whitehead** was re-elected hon. treasurer and **Dr. B. P. Dudding** re-elected hon. secretary. The three new ordinary members of the board elected were **Dr. M. R. Hopkins, Dr. J. M. A. Lenihan** and **Dr. J. Taylor.**

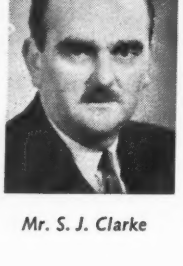
Mr. Leslie Gamage, vice-chairman and joint managing director of the General Electric Co., Ltd., has been re-elected president of the Institute of Export for the thirteenth year in succession.

Mr. D. R. S. Turner, B.A., A.M.I.E.E., has been appointed manager of the Larne Works (Northern Ireland) of the British Thomson-Houston Co., Ltd., which when completed will be devoted to the manufacture of steam turbines and turbo-generators of 30 MW upwards, and in addition will provide the turbine-blade requirements for both Larne and Rugby products. The blading shop at Larne is already in production.

Mr. Turner, after graduating (hons. mechanical science tripos) at Cambridge (1938), entered upon an extensive period of practical training in Switzerland and in the United Kingdom, including the B.T.H. Co., Rugby, and the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, followed by six years' active service in the Royal Navy as an engineer officer. In 1946 he joined the staff of the B.T.H. Turbine Contracts, and in 1950 was appointed assistant manager of that department. He returned to the manufacturing side in 1953 as assistant general superintendent, Rugby works, with special responsibility for what was then designated the Larne project.

Mr. S. J. Clarke, T.D., Associate I.E.E., has been appointed manager of the Manchester district office of the British Thomson-Houston Co., Ltd., with effect from 31st May. **Mr. F. C. Barford,** T.D., M.I.E.E., whom he succeeds, becomes manager of the company's Birmingham district office, with effect from 15th June, and he will succeed **Mr. J. Clement,** who will shortly take up another position with the B.T.H. organization.

Mr. D. R. S. Turner



Mr. S. J. Clarke

Mr. F. C. Barford

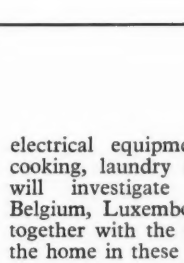
Mr. Clarke, until recently manager of the B.T.H. Newcastle-on-Tyne district office, was educated in Hong Kong and served an indentured apprenticeship there with the Hong Kong Electricity Co., Ltd., before coming to England in 1930 as graduate apprentice with the B.T.H. and in 1933 he was posted to the Swansea district office. He was commissioned in the R.A.O.C.(E.) in 1939 and transferred to R.E.M.E. in 1942. On demobilization in 1945 as lieutenant-colonel, Mr. Clarke returned to the Swansea district office, and in 1948 was appointed to the managership of that office, moving to Newcastle as manager in 1952. As previously announced, Mr. Clarke is succeeded at Newcastle by Mr. H. G. Harlow.

Mr. Barford, who has been manager of the B.T.H. Manchester district office since 1952, was educated at the Lawrence Sheriff School, Rugby, and served an engineering student apprenticeship with the B.T.H. Co., later joining the Glasow district office. He was commissioned in the R.A.O.C. in 1939, and transferred to R.E.M.E. on its formation in 1942. On demobilization (as lieutenant-colonel) in 1945 he went to the Manchester district office. The following year he was transferred to Newcastle as deputy manager, and in 1947 was appointed manager. In 1953 Mr. Barford took over the managership of the company's Manchester office.

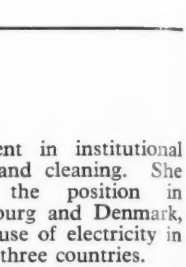
Mr. T. E. Trotman, formerly sales manager of Thor Appliances, Ltd., has joined the Household Sales Department of Frigidaire, Hendon.

Miss Mary S. Mitchell has been awarded the 11th Travelling Exhibition by the Caroline Haslett Trust, which enables holders to study some aspect of domestic electrification in another country. She is senior demonstrator of the St. Pancras District, London Electricity Board, and chairman of the Association of Electrical Housecraft Advisers, and is especially interested in the use of modern electrical equipment in institutional cooking, laundry and cleaning. She will investigate the position in Belgium, Luxembourg and Denmark, together with the use of electricity in the home in these three countries.

Alderman B. H. Gardner, who has been appointed a part-time member of the East Midlands Electricity Board, has had a long experience in electricity supply having been a member of the Coventry Corporation Electricity



Ald. B. H. Gardner



Mr. J. F. Stanier

Committee since 1933 and chairman for five years before nationalization. He was Lord Mayor of Coventry for 1952-53.

Mr. J. F. Stanier, who is also a part-time member of the Board, is chairman of the Renishaw Iron Co., Ltd., and is a member of the Derbyshire County Council.

At a meeting of the Council of the Electric Lamp Manufacturers' Association held on 17th May **Mr. V. C. H. Creer,** of the British Thomson-Houston Co., Ltd., was re-elected chairman of the association for the year commencing 1st June.

Mr. H. S. Arms, M.A., M.I.Mech.E., D.Phil., F.Inst.P., who, as reported elsewhere in this issue, is chief engineer, Rugby, with the English Electric Co., Ltd., joined the company in 1953 as chief development engineer, Rugby. He was a Rhodes Scholar at Oxford University, where, as a member of Jesus College, he obtained his B.Sc. (Physics) in 1938, and was awarded a doctorate in physics in 1949. In 1939 he became a demonstrator at the Clarendon Laboratory and from 1940 to 1945 he worked under Professor (now Sir) Francis Simon.

Dr. Arms was lent to the National Research Council of Canada in 1945, working at Montreal and at Chalk River on experimental heat transfer for the "NRX" reactor. From 1946 to 1950 he was principal scientific officer in charge of the Engineering Laboratory of the Atomic Energy Research Establishment, Harwell. He then became assistant chief engineer

and later deputy chief engineer in charge of research and development at the Capenhurst plant of the Production Division of the Atomic Energy Department.

Mr. D. H. Brown, of the English Electric Co., Ltd., and an honours graduate of St. Andrew's University, has been appointed by the Northern Ireland Ministry of Commerce to the new post of engineer in charge of plans for the use of nuclear energy in the generation of electricity. He will shortly join a special course of training with the United Kingdom Atomic Energy Authority.

The Metropolitan-Vickers Electrical Co., Ltd., has appointed **Mr. W. F. Crowther** as manager, Hull sub-office, and **Mr. J. S. Hall** as assistant manager, Manchester office. Mr. Crowther joined the Metropolitan-Vickers Electrical Co. in 1916 and has represented the company in the Hull area for many years. Mr. Hall went to M-V as a school apprentice in 1921, following which he spent two years abroad with Babcock & Wilcox. He returned to Trafford Park in 1926, and later held positions in the company's offices in Cardiff, Bristol and Swansea, being appointed manager of the Swansea sub-office in 1949. In 1952 he transferred to the Manchester office staff as senior assistant.

Mr. J. G. Holmes, B.Sc., A.R.C.S., F.I.E.S., chief technical officer, Holophane, Ltd., whose election as hon. secretary of the Illuminating Engineering Society for the 1955-56 session was reported in our last issue, was president of the I.E.S. in 1951-52. He is the author of many papers on illumination, particularly on industrial lighting, and he represents the Society on various outside committees. As a member of the National Illumination Committee he is attending the C.I.E. world conference on lighting and vision to be held at Zurich in June.

Mr. J. G. Holmes

Mrs. B. S. Gylee has been appointed E.A.W. organizer of the South Wales area, and will take up her duties from 1st June next. She is a member of the Swansea and District Branch.

Mr. E. Bruce Ball has resigned as managing director of Glenfield & Kennedy, Ltd., and from the boards of Glenfield & Kennedy (Holdings), Ltd., and associated and subsidiary companies.

Sir Summers Hunter is relinquishing the position of managing director of Richardsons, Westgarth & Co., Ltd. (parent company) on 31st July next on reaching the group's retirement age. He will remain a member of the board and his services will continue to be available to the group in a consultative capacity. **Mr. J. R. Mackay,** at present deputy managing director of the parent company, has been appointed managing director with effect from 1st August next.

Dr. A. L. Cullen, B.Sc., A.M.I.E.E., Reader in Electrical Engineering at University College, London, has been appointed to the newly-created Chair of Electrical Engineering in Sheffield University.

Mr. D. Bryars has been appointed to the board of directors of the Sheffield Smelting Co., Ltd., with special responsibilities in the field of sales control. **Mr. R. R. Ellerby,** F.C.I.S., F.R.Econ.S., secretary, has been appointed a special director.

Mr. Cyril O. Smith, for many years manager of Cricklewood Wholesale Electric, Ltd., has been appointed to the board following the death of Mr. W. Bates, managing director. Mr. Smith becomes joint managing director with Mr. Ed. W. Jermey, chairman of the company.

Mr. Sean MacEntee has been elected to the board of Brush Aboe (Ireland), Ltd., the Irish subsidiary of the Brush Group, Ltd. Mr. MacEntee is a former Finance Minister of the Republic of Ireland and has also been Minister for Local Government and for Industry and Commerce.

Mr. L. A. Fickling, sales manager of Linolite, Ltd., is sailing in the *Arundel Castle* on 23rd June for a business visit to South Africa and Rhodesia. It is his intention to hold trade shows in hotels in Cape Town, Durban, Johannesburg and Salisbury. He will return to Southampton in the *Carnarvon Castle* on 19th August.

Mr. H. Jefford, director of a Midlands export packing and casemaking firm, was elected chairman of the Institute of Packaging at the recent annual general meeting held in Liverpool.

At an informal gathering immediately before the annual general meeting of **A. Reyrolle & Co., Ltd.,** Sir Claude Gibb, chairman, presented long-service awards to a further fourteen employees who have completed forty years' service with the company. This brings the total of these long service awards to ninety-three.

Members of the South Staffordshire branch of the Electrical Contractors' Association entertained **Mr. F. J. Elliott,** Wolverhampton Sub-Area manager of the Midlands Electricity Board, on 16th May, at a dinner in his honour before he shortly leaves his present appointment. Mr. Elliott intimated that he was not retiring entirely from the service of the Board and that he would undertake special liaison duties between the Board and its Sub-Areas. Mr. H. F. Marshall, chairman of the South Staffordshire branch of the Association, was chairman at the dinner. With Mr. H. F. Truman (Walsall), Mr. C. G. Evans, Mr. W. H. Podmore and Mr. R. A. Joseph he expressed appreciation of Mr. Elliott's help to electrical contractors during his long period both as borough electrical engineer of Wolverhampton and Sub-Area manager to the M.E.B. Mr. Marshall presented Mr. Elliott with a case of pipes as a gift from the Association.

Mr. S. Hardy (right) the new chairman of the Ipswich and District Electrical Association, receiving the badge of office from Mr. H. E. Wright, the retiring chairman, at the recent annual general meeting. With them is Mr. H. P. Thompson, retiring hon. secretary, who is the new vice-chairman

At the recent annual general meeting of the **Leicester Electrical Society** the following officers and committee were elected:—President, Mr. G. E. Jackson; vice-presidents, Mr. K. Broom, A.M.I.E.E., and Mr. J. J. Hayman; hon. secretary, Mr. R. March; hon. treasurer, Mr. G. Stephens; hon. auditors, Mr. B. N. Rowe and Mr. F. C. Blackwell.

Increased overseas and home sales of measuring and control equipment made by George Kent, Ltd., has necessitated some expansion and reorganization of the sales staff. **Mr. J. M. White,** lately chief sales engineer, is being appointed to the London office on his return from a visit to Canada and **Mr. J. Tham** has been appointed chief sales engineer in succession to Mr. White.

The East Midland Area finals of the **E.I.B.A. National Golf Championship** will be held on 6th July at Rushcliffe Golf Course, East Leake, Notts. Particulars can be obtained from the hon. secretary, Mr. P. M. Furse, Furse Wholesale, Ltd., Traffic Street, Nottingham.

Parents' Day, which was held recently at the **British Thomson-Houston Co.'s** Rugby Works, was attended by more than 650 parents and friends of apprentices in their first year. In the morning the guests visited the Rugby College of Technology and Arts and during the afternoon they toured the various factories of the Rugby Works, afterwards going to the apprentice residence, Coton House, for tea. After tea, Mr. H. E. Cox (manager, Rugby Works) welcomed the guests and introduced the Mayor of Rugby, Councillor W. A. Manning, who spoke of the part played by the

B.T.H. Co. in the prosperity of the town. He was followed by Mr. C. Grad (manager, B.T.H. Education Department) who deputised for Mr. L. J. Davies (director, research and education). After the speeches Mrs. H. E. Cox presented certificates to apprentices who had shown outstanding diligence and ability during their course of training. The day ended with a display of fire fighting and rescue work by the Coton House fire brigade.

The latest production of the **Johnson & Phillips Amateur Dramatic Section** was "Here We Come Gathering," by Phillip King and Anthony Armstrong, which was presented on 12th, 13th and 14th May at Fairthorn Road, Charlton, S.E.7. The play attracted good houses on each evening.

The Amateur Dramatic Society of **Siemens Brothers & Co., Ltd.,** presented the Ben Travers' farce "Wild Horses" on 7th and 14th May. Among the audiences who enjoyed this play were Mr. H. E. Humphries, managing director of the company, Mr. W. G. Patterson, deputy managing director, Mr. W. Newbold, Woolwich works manager, Mr. F. G. Pheazey, telephone department manager, Mr. W. T. Pope, labour manager, and representatives from neighbouring works and dramatic societies. This successful play was given a third performance at the Queen Mary's (Roehampton) Hospital on 19th May for the patients and staff.

The annual Liverpool-Manchester electrical trades inter-city golf match for the **J. H. Farthing Trophy** was played over the course of the Mere Golf and Country Club on 18th May. Of the twelve matches played, Manchester won six, Liverpool three and three were all square. Manchester thus retains the trophy for another year. The captains, Mr. J. B. Hartley (Manchester) and Mr. J. T. Dennis (Liverpool) presented four tankards to the two competitors of each side who won their matches by the biggest margins. They were Mr. G. C. Venables and Mr. F. P. Dennis (Liverpool) and Mr. R. T. Monks and Mr. A. Bailey (Manchester). Trophies were handed to those who won them by Mr. A. J. Emery. Arrangements for the match were made by Mr. F. J. Burns (Cryselco, Liverpool) and Mr. E. G. Taylor (G.E.C., Manchester).

The annual cricket match between the **Electrical Trades Commercial Travellers' Association** and the senior boys of the Royal Commercial Travellers' School takes place on 4th June (2.30 p.m.) at the school at Hatch End, Pinner. Members of the E.T.C.T.A. and their families (children 10 years or over) are invited to attend.

OBITUARY

Mr. W. E. Shuttleworth.—The death has occurred at his home at Cottingham (East Yorkshire), of Mr. William Ernest Shuttleworth, principal of the Humber Electrical Engineering Co., of Hull, the firm he founded in 1911. He was seventy-one years of age. Mr. Shuttleworth served for some time as chairman of the Hull and District branch of the Electrical Contractors' Association.

Mr. W. G. Heath.—The death occurred on 20th May at his home at Stafford of Mr. William George Heath, chief cashier of the English Electric Co., Ltd.

ATOMIC ENERGY LECTURES

In conjunction with the Yorkshire Council for Further Education a course of five lectures on Atomic Energy Applied to the Electrical Engineering Industry will be held on Tuesday evenings at 7 p.m., commencing on 7th June, at the Technical College, Bradford. The course will deal with those basic principles of atomic energy and radio-activity which the electrical engineer may require in order to appreciate fully the developments which are being made in this new field of engineering, and with the design, control and instrumentation of nuclear reactors for power station use.

Students should possess a degree, higher national certificate, or other suitable qualification.

The lectures will be as follows: 7th, 14th and 21st June, "Principles and Engineering Application of Atomic Energy, Radioactivity, and Health Physics," by B. Fozard, B.Sc., senior lecturer in electrical engineering, Bradford Technical College; 28th June, "Reactor Design and Future Trends," by D. V. Wordsworth, B.Sc., chief lecturer, Harwell Reactor School; and 5th July, "Control and Instrumentation of Reactors," by I. Wilson, B.Sc., senior member, Reactor Instrumentation and Control Group, Harwell. The fee for the course is £1 10s.

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £163 0s 0d
COPPER, H.C. Electro	ton £328 10s 0d
Fire Refined 99·70%	ton £327 0s 0d
Fire Refined 99·50%	ton £326 0s 0d
COPPER Tubes ..	lb 3s 1¼d
Sheet	ton £389 5s 0d
H.C. wire and strip ..	ton £362 5s 0d
LEAD, English ..	ton £103 15s 0d
Foreign	ton £102 0s 0d
MERCURY	flask £108 0s 0d
TIN, block (English) ..	ton £714 15s 0d
ZINC, G.O.B. Foreign	ton £90 0s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)..	lb 2s 5⅞d
Sheet	ton £310 10s 0d
Wire	lb 3s 1¼d
PHOSPHOR BRONZE Wire	lb 4s 7⅛d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 27⅛d—27⅝d

RECENT C.E.A. CONTRACTS

Contracts have been placed by the Central Electricity Authority during the past month for power stations, transforming stations and transmission lines, amounting in the aggregate to £17,955,750. The principal contracts include the following:—

Marchwood power station, near Southampton: One reinforced concrete chimney.—J. L. Keir & Co.

Portishead "B," near Bristol: Condensing and feed heating plant for one 60,000 kW turbo-generator set.—Metropolitan-Vickers Electrical Co.

Tilbury: Ash and dust handling plant.—Babcock & Wilcox.

Castle Donington, near Derby: One 100,000 kW turbo-generator, feed heating and evaporating plant.—Metropolitan-Vickers Electrical Co. High pressure pipework and valves.—Aiton & Co.

Willington "A," near Derby: Main civil engineering works.—Marples, Ridgway & Partners. One 100,000 kW turbo-generator, condensing and feed heating plants.—English Electric Co. 132 kV, 3,500 MVA switchgear.—General Electric Co.

Northampton: Superstructure.—Rush & Tompkins.

Rogerstone, Mon: Main civil works.—Sir Robert McAlpine & Sons (South Wales). Structural steelwork.—Braithwaites & Co. (Structural).

Elland, Yorks: Main foundations and circulating water system.—Yorkshire Hennebique Contracting Co. 132 kV, 3,500 MVA switchgear.—English Electric Co.

Skelton Grange "B," Leeds: Two 60,000 kW turbo-generators and two generator transformers.—C. A. Parsons & Co. Condensing and feed heating plants for two 60,000 kW sets.—G. & J. Weir. One 60,000 kW turbo-generator set, condensing and feed heating plants.—Richardsons, Westgarth (Hartlepool).

Mexborough, Yorks: 66 kV, 1,500 MVA switchgear.—English Electric Co.

Blyth "A," Northumberland: Foundations for main and ancillary buildings.—Sir Robert McAlpine & Sons (Newcastle-upon-Tyne). Two 120,000 kW turbo-generators, condensing and feed heating plants.—Metropolitan-Vickers Electrical Co.

Stella South, near Newcastle-upon-Tyne: One 72 MVA, 141·6/11·8 kV generator transformer.—C. A. Parsons & Co.

Iver, Bucks: Two 120 MVA, 275/66 kV transformers.—Crompton Parkinson.

Coalville, Leics: 132 kV, 2,500 MVA switchgear.—A. Reyrolle & Co.

Connah's Quay, near Flint: 132 kV, 3,500 MVA switchgear.—Ferguson Pailin.

Agecroft, Salford: 132 kV overhead line.—W. T. Henley's Telegraph Works Co.

Hams Hall, near Birmingham: 275 kV overhead line.—B.I. Callender's Cables.

BRITISH PLASTICS EXHIBITION

Plastics in all its applications including electrical uses will be seen at the third British Plastics Exhibition, which opens at Olympia, London, on 1st June and continues until 11th June. Raw materials and plant used in the industry will also be on view. Leading manufacturers of narrow-gauge steel tube have now entered the plastics field and are to show their first examples of plastics tube.

Running concurrently with the Exhibition, there will be a Convention at which twenty papers dealing with most aspects of the plastics industry will be discussed. The Exhibition and Convention are organized by *British Plastics*, Associated Iliffe Press, Dorset House, Stamford Street, London, S.E.1, with the co-operation of the British Plastics Federation.

INDUSTRIAL NEWS

Engineers' Appointments Bureau

The Professional Engineers' Appointments Bureau, 9, Victoria Street, London, S.W.1, reports that in 1954 particulars of over 9,000 engineers were submitted by it for vacancies notified in civil, mechanical and electrical engineering. This is the highest annual number of submissions that has been recorded so far. There have been many placings in all three branches of engineering. The number of registrations with the Bureau, many from overseas, show an increase. The main demands in civil engineering have been for engineers with wide design experience, good contractors' experience and for young engineers prepared to accept overseas posts. There has also been a big increase in technical vacancies notified by local authorities. In mechanical engineering, requirements have been varied and have included posts for engineers with experience in chemical engineering plant, hydraulics, servo-mechanisms, production and management. The major proportion of electrical vacancies have called for experience in the sphere of electronics and light current engineering including instruments.

Generating Plant in a Sugar Factory

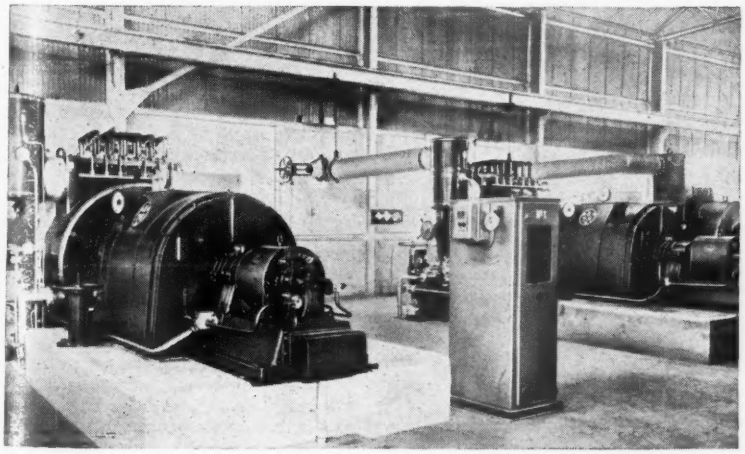
A new power station has recently been put into commission by the Ste. Madeleine Sugar Co., Ltd., at the Trinidad factory managed by Henckell du Buisson & Co., London, where something like 56,000 tons of sugar is produced annually. The generating equipment consists of two new B.T.H. 1,250 kW 3,600 r.p.m. single-stage back-pressure steam-turbo sets having two rows of rotating buckets, and one existing B.T.H. 1,000 kW set which has been transferred from the old generating station.

Steam conditions of the new sets are: normal conditions 165 lb/sq in superheated to 100 deg F and exhausting against a back pressure of 10 lb/sq in. The machines are also capable of carrying their continuous maximum rating at 140 lb/sq in with 50 deg F superheat. The electrical conditions are: 480 V, 60 c/s, 3 phase, 0·8 p.f. with direct-coupled exciter; an enclosed air-cooling system is embodied.

A completely new B.T.H. switchboard has been installed in the power station, an interesting feature of which is the use of electronic voltage regulation. The board has 18 panels and is of the slate "dead front" type. It is unusual in design, in that the circuit-breakers, which are of the airbreak Type VJ at 480 V, are not mounted immediately behind the front panels but are placed in separate compartments isolated from the front panels by a 3ft wide passageway extending the length of the switchboard. The breakers are manually operated from the front panels through mechanical linkages beneath the floor on which the switchboard stands. At the rear of the breaker compartments is a further 3ft passageway. This switchboard arrangement has been adopted to facilitate maintenance and cleaning, which must be carried out frequently owing to the presence of very fine dust.

For speech communication between the new power station and the diesel station in the factory precincts "Clear-call" equipment is used and the power station is illuminated by B.T.H. lighting units.

Electrical ends of the two new 1,250 kW sets at the Trinidad sugar factory



English Electric Television Showroom

Following the recent opening of the new demonstration kitchen, in its Queen's House showroom, the English Electric Co., Ltd., has now completed a new television viewing room adjoining the main showroom. The range of "English Electric" 21in and 17in receivers introduced to the market this month, several of which are equipped for v.h.f. sound reception for the first time, will be on permanent display. The new viewing room has been designed by Mr. Albert Smith, who has made use of contemporary materials, style and colour schemes. The two lighting fittings have been specially designed to illuminate the room without throwing any reflection upon the screens of the television receivers being displayed.

The new television showroom of the English Electric Co., Ltd., at Queen's House, Kingsway, W.C.2

E.L.F.A. and "Recognized Users"

The Electric Light Fittings Association announces that it has reduced to 10 per cent the basic discount allowed by its members and by its approved wholesalers to "recognized users" (as defined in the Electrical Fair Trading Policy) on all kinds of industrial and commercial lighting fittings. The Association hopes that this change will give further encouragement to the electrical trade to develop new business with this class of customer in lighting fittings made by E.L.F.A. members, a list of whom can be obtained from the Association, 103, Kingsway, London, W.C.2.

Egyptian Police Radio Network

An order has been received by Marconi's Wireless Telegraph Co., Ltd., from the Egyptian Police Authorities for the supply of a large quantity of radio equipment. The order, which was obtained in competition at home and abroad, includes the supply of 221 v.h.f. mobile stations,

132 fixed station transmitters and 139 fixed station receivers, for general coverage of the country as a whole. In addition, an inter-city h.f. system has been planned involving the supply of twenty-four 500 W transmitters together with associated h.f. receivers and receiving terminal equipments. Each station installation will be supplied complete with all necessary aerial systems, masts, diesel generator sets, charging sets and other ancillary equipment.

Chelsea Flower Show

How electricity helps the keen gardener with limited time who wants to obtain the best results from his efforts, is demonstrated on Stand No. 28, Eastern Avenue, at the Chelsea Flower Show which concludes to-day (Friday). Organized by the British Electrical Development Association, the display reproduces the electrically-equipped amateur greenhouse which has been a feature of the B.B.C. Sunday afternoon gardening programme, "Home Grown." The greenhouse contains thermostatically-controlled tubular heating. A special item is the covered bench, or "greenhouse within a greenhouse" across one end of the house. This propagating case is kept at 55 deg F by a thermostatically-controlled electric air heating cable, and a hand-controlled soil warming cable bedded in sand and covered with peat. Low-voltage soil warming is also demonstrated.

Valve Makers' Extension

Mullard, Ltd., have acquired over 20,000 sq ft of factory space in premises at Cromwell Road, Hove, near the company's existing factory. This new extension is expected to produce over six million valves in the next two years and will open with a small initial staff shortly. It is expected that up to 350 new staff will be required during the next year or so.

Visit to Research Laboratories

A party of twenty-four members of the Parliamentary and Scientific Committee recently visited the Wembley Research Laboratories of the General Electric Co., Ltd. The Committee, a non-party body composed of members of both Houses of Parliament and representatives of scientific institutions, provides liaison between scientific bodies and Parliament.

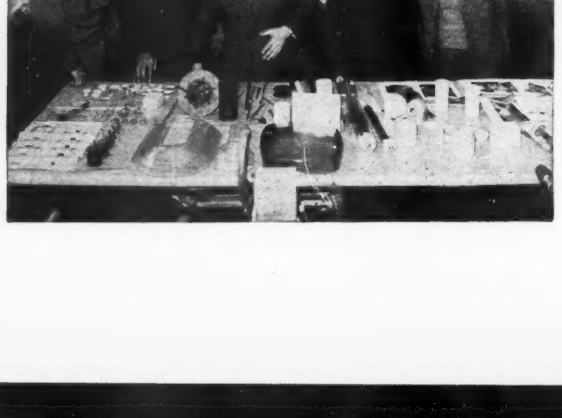
During their tour members were shown many of the most important activities of the laboratories, including work on semi-conductors, high power rectifiers, electronic valves, lamps, glass and refractories, and metallurgy. The visitors were afterwards entertained to luncheon, with Mr. O. W. Humphreys, director of the laboratories, in the chair.

Instrument Company's "At Home"

The Cambridge Instrument Co., Ltd., held an "at home" on 4th and 5th May, for which invitations were issued to the professors, teaching staff, research students and senior men taking science subjects in the University of Cambridge. Some 600 accepted the invitation when all sections of the factory and research departments were open for inspection and a number of demonstrations were in progress. The visitors included the Mayor of Cambridge with civic officials, and several Masters of Colleges. Of particular interest was the apprentices' school and training department. Each day, the visitors were entertained to tea in the company's canteen.

Woods' Millionth Fan

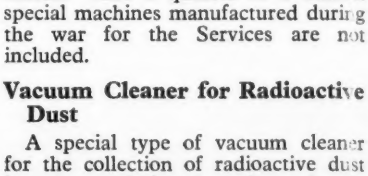
At Woods of Colchester, Ltd., on 26th April, staff and visitors watched the assembly and testing of the millionth fan in the company's machine-number record. The final nut was formally tightened by Mr. A. E. Watson, a director of J. T. Meredith & Co., Ltd., consulting engineers, who ordered the fan, a 48in diameter two-stage "Aerofoil" unit with contra-rotating impellers. The fan will be employed in the air conditioning system for the new Cardiff branch of British Home Stores, Ltd. The number of fans produced by Woods is actually well over a million. Many thousands of small fans that do not receive a serial number are not included in the machine-number record. Also a quarter of a million special machines manufactured during the war for the Services are not included.



Dr. J. H. Partridge of the G.E.C. Research Laboratories, discussing research into glass and refractories with visiting members of the Parliamentary and Scientific Committee; second from left (foreground) is Sir Hugh Linstead, chairman of the Committee, with (left to right) Dr. Partridge, Mr. N. Sheldon (British Association of Chemists), Viscount Falmouth, and Mr. H. Norman Smith

Vacuum Cleaner for Radioactive Dust

A special type of vacuum cleaner for the collection of radioactive dust has been designed and made by Hoover, Ltd., to the requirements of the Atomic Energy Research Establishment at Harwell. Basically cylindrical in shape, it stands 1ft 5in high and is 2ft 2in long by 1ft 3in wide. The air, with its dust particles, is drawn in on the inlet side of the machine via the cleaning tools and special smooth-bore hose. The dust is collected in two replaceable filter units, the first of which uses a special cloth as a filtering medium and the second a 1in thick wool pad impregnated with resin by a special process. The filtering units each consist of two 13in diameter moulded cones placed back to back with their filtering mediums clamped between the two. The action of these filters removes dust particles down to the size of 0·3 micron. A hose is available on the exhaust side of the machine for the controlled disposal of the filtered air, if desired.



Special Hoover vacuum cleaner in use at Harwell

"To Shape Tomorrow"

The latest addition to the films produced by Bakelite, Ltd., is "To Shape Tomorrow," which had its preview last week in London. This is concerned with four of the materials produced by the company, foundry steel-moulding resins, polyester resins, "Vyrak" vinyl materials and "Warerite" decorative laminates. The film shows the extent to which we have come to rely upon plastics for things which are in use every day. It opens with "Mr. Everyman" awaking in the morning, the telephone which wakes him, the lighting and the heating all being examples of the application of plastics. From there the film goes to the company's works and shows the manufacture of these materials,

returning to Mr. Everyman's home at the end of each sequence to show how these materials are used in other ways in the kitchen by Mr. Everyman before he leaves for the office.

The film is available in 35 mm and 16 mm Eastmancolour prints, and is intended for free private showing to any technical or lay audience. Requests for the loan of the film should be addressed to the Publicity Department, Bakelite, Ltd., 12-18, Grosvenor Gardens, London, S.W.1.

Atomic Energy Exhibitions

In a leaderette in this issue we refer to two exhibitions which are being organized by the United Kingdom Atomic Energy Authority in connection with the international conference of scientists at Geneva in August (8th to 20th). To co-ordinate the commercial exhibits a central committee has been formed, under the chairmanship of Mr. Eric H. Underwood, C.B.E., director of public relations to the Authority. It includes representatives of the Federation of British Industries, the nucleonics industry, civil engineering contractors, boiler-makers and manufacturers of electrical and generating equipment.

Mr. N. C. Pratt (Philips Electrical, Ltd.) is acting as honorary co-ordinator to the commercial exhibition committee. He is being assisted by Mr. N. H. Campbell, to whom firms who have not already booked space and wish to do so, should write. His address is Oxford House, 9-15, Oxford Street, W.1 (Gerrard 7031). Inquiries of a technical character should be addressed to Mr. Underwood at the United Kingdom Atomic Energy Authority, St. Giles Court, 1-13, St. Giles High Street, London, W.C.2.

Vacuum Cleaner Salesmen Summoned

Four vacuum cleaner sales representatives of a Manchester firm, the Victoria Electrical Co., were summoned at Bradford on 6th May for acting as pedlars without certificates. They were Kenneth Nelson (aged 24), Kenneth Cassidy (aged 27), John Grieve (aged 25) and Cuthbert Whitehead (aged 28). James Henry Lavery (aged 27), area manager of the company, was summoned for aiding and abetting. All pleaded "Not guilty."

Insp. P. R. Page, prosecuting, alleged that the defendants had travelled from Manchester in a van for the purpose of selling vacuum cleaners. They were seen to go from door to door of houses in Bradford streets.

Mr. B. A. Hytner, defending, said it was believed to be the first prosecution of its kind against a vacuum cleaner salesman, working this system, in 35 years. He said that the men called at houses to give demonstrations. If a sale was agreed subsequently, hire purchase agreements were entered into. He submitted that the 1871 Pedlars Act was not intended to include respectable sales representatives, but was aimed at the wandering pedlar, tinker and person who was "a bit of a vagabond."

The magistrates announced that they would give their decision to-day (Friday).

Equipment for Suburban Trains

The General Electric Co., Ltd., has received an order from the British Transport Commission for the complete traction equipment of fifty-seven new three-coach multiple-unit train sets to replace existing rolling stock on the Euston-Watford service, London Midland Region. Each three-coach set will consist of a motor-coach, trailer and driving trailer. The rolling stock, to be built in British Railways workshops, will be of the compartment type with central corridor. This will be the first order for which the G.E.C. will manufacture all the traction motors and auxiliary machines in its new factory at Dudley Port, acquired recently to meet the growing demand for electric and diesel-electric traction equipment. The value of the order is approximately £741,000. Each motor-coach will be powered by four axle-hung self-ventilated motors of 206 h.p. at the one-hour rating. A ductless ventilation system will be adopted, the motor air intakes themselves being provided with air cleaning arrangements.

The electro-pneumatic contactor control equipment will be underframe-mounted and will provide series-parallel and parallel connections of the four motors, which will be grouped in pairs, the motors of each pair being permanently in parallel. There will be four economic running speeds, two weak-field steps being provided in the parallel connection. The equipment is designed for an initial rate of acceleration of 1·27 m.p.h./sec and a maximum safe operating speed of 70 m.p.h.

This will be the fourth order fulfilled by the G.E.C. in connection with the Euston-Watford trains. Since 1926 the company has supplied traction equipments for twenty-five motor coaches, twenty-five driving trailers and twenty-two trailer coaches operating on this service.

Refrigerator Demonstration

Recently Kelvinator, Ltd., gave a display of its 1955 refrigerator models at the Piccadilly Hotel, London, at which it introduced the "Polarsphere" internally mounted sealed unit. With the aid of microphones and amplifiers it was shown convincingly how this device enables a manufacturer of compressor refrigerators to claim real silence in operation. Another feature of design emphasized was the small amount of floor space required. After the demonstration a film was shown of the production methods at the company's Crewe factory.

At present the company is exporting a very high proportion of its output: it claims in fact to be responsible for over 80 per cent of the country's domestic refrigerator exports. With the completion of a new factory on Merseyside, however, it is hoped within two years not only to meet home demands for refrigerators but to introduce other domestic electrical appliances as well.

Trade Announcements

The new Manchester branch of **Brown Brothers, Ltd.,** at Irwell Street, Salford, Lancs (telephone: Blackfriars 2472), will be opened on 31st May.

The Glasgow divisional sales office of "Servis" electric washing machines of **Wilkins & Mitchell, Ltd.,** is now at 56, St. Vincent Crescent, Glasgow, C.3 (telephone: Central 6629).

The Thermovent heating division of **E. K. Cole, Ltd.,** announces the appointment of Mr. E. J. Bolan as technical sales representative covering the South-East and South-West areas of London. He can be contacted through the London office of the company, 5, Vigo Street, London, W.1 (telephone: Regent 7030).

CATALOGUES AND LISTS

COOKING EQUIPMENT.—Illustrated leaflet describing the "Crypto-Rotapan" steam cooking appliance for catering establishments and canteens for cooking, conserving and reviving foods.—**Crypto, Ltd.,** North Circular Road, London, N.W.10.

FORK TRUCKS.—Six illustrated brochures describing a new range of fork trucks and the "Skid-Stac" attachment. — **Conveyancer Fork Trucks, Ltd.,** Liverpool Road, Warrington.

INDUCTION HEATING. — Technical booklet (32 pp.) dealing with r.f. induction heating and showing many of the applications where this type of heating is used.—**Radio Heaters, Ltd.,** Eastheath Avenue, Wokingham, Berks.

INSULATION.—A 20-page booklet giving technical information regarding the company's range of insulating materials in mica and laminated plastic.—**Langley London, Ltd.,** Kelvin Way, Crawley, Sussex.

LAMPS.—Leaflet and priced sheet dealing with the "Osram" range of fluorescent tubes. —**General Electric Co., Ltd.,** Magnet House, Kingsway, London, W.C.2.

LIGHTING FITTINGS.—12-page catalogue illustrating and describing a range of "In-Bilt" lighting fittings.—**Holophane, Ltd.,** Elverton Street, London, S.W.1.

OSCILLOGRAPHS.—8-page illustrated booklet (L.516) summarizing the working principle of the company's cathode ray oscillographs and showing examples of industrial and scientific applications of these instruments.—**A. C. Cossor, Ltd.,** Highbury Grove, London, N.5.

POWER REGULATOR.—Leaflet (2.B) describing the "Synchroheat" type 50-1 power regulator for furnace and oven heat control, fluorescent lamp dimming, etc.—**Bates & Bates, Ltd.,** 73, Ashville Avenue, Birmingham, 34.

PUMPS.—Brochure (1485) illustrating and describing a range of electrically driven pipeline mounting "Mopump" hot water accelerator pumps.—**Rhodes, Brydon & Youatt, Ltd.,** Gorsey Mount Street, Stockport.

SOLDER.—Technical leaflet dealing with the soldering of printed circuits and showing the range of "Multicore" materials available for this purpose.—**Multicore Solders, Ltd.,** Maylands Avenue, Hemel Hempstead, Herts.

Plant Engineers' Conference

Proceedings at the Technical Sessions

MORE than two hundred delegates and their ladies attended the eighth annual conference of the Incorporated Plant Engineers, which was held at the Hotel Majestic, St. Annes-on-Sea, last week (18th to 20th May). The proceedings began on the Wednesday afternoon with a short conference between the branch secretaries, after which the annual general meeting was held.

The annual report and statement of accounts showed that during last year the membership increased by 158 to 3,095; during the first quarter of 1955, 193 candidates were admitted to membership. After the meeting there was an informal dinner followed by dancing for the rest of the evening.

On Thursday morning (19th May) Mr. G. Sievewright was installed as the new president. In his inaugural address he said that with the advent of the industrial revolution the engineer sprang into sudden and unfavourable prominence. To-day, little of that prejudice remained, but as old problems were solved new ones took their place. Our former overseas customers had created their own manufacturing industries and were less interested in buying manufactured goods from us than in buying machinery with which to set up on their own. They also had the advantage of cheaper labour. If we were not to see a serious decline in our standards and know real want we must now satisfy exacting standards of cost, quality and delivery against intense competition.

As Sir Claude Gibb said recently, the contribution which works and plant engineers could make to increased productivity was not by any means generally recognized. Plant and equipment, not only kept in operation for every hour the factory was open for work, but also modernized and kept at peak efficiency, was vital. Mr. Sievewright also referred to the Institution's examination scheme which was to be conducted by the City and Guilds of London Institute. It had already attracted favourable interest and courses were to start at a number of colleges this autumn.

Machines and Prosperity

Mr. E. E. Butten, chairman of Personnel Administration, Ltd., then delivered a lecture entitled "Plant, People and Prosperity." He began by saying that fifty years ago prosperity meant the prosperity of the few but to-day it meant a general rise in the standard of living of everyone. Increased prosperity was synonymous with more machines. The plant engineer was not only deeply concerned with helping to provide the fruits of prosperity but also in helping to achieve it.

In 1954 investment in plant, machinery and industrial buildings was £853 million, an increase of 3 per cent on 1953. The increase in the rate of industrial building was even greater. As a result, the amount of plant and capital equipment per direct operative was steadily increasing. In the chemical industry it was already £12,000 per operative and a figure of £3,000 or more in other industries was not uncommon. Keeping the new plant and equipment running efficiently and economically was the responsibility of the plant engineer. Automation would increase this responsibility, automation being defined as "the operation, control and scrutiny of machines by other machines, instead of by the human brain." A good example was in the new Ford plant in Cleveland, Ohio, where a series of electronic computers and automatic machines, serviced by 250 skilled men, turn out in one day twice as much work as was formerly done by 2,500 operatives.

In the afternoon the delegates divided into four discussion groups. Under the chairmanship of Mr. R. H. Cobbold, the first group dealt with electrical safety in factories, the opening speaker being Mr. H. W. Swann, formerly H.M. Senior Electrical Inspector of Factories. Mr. Swann said that the increasing scale of electricity supply was leading to injuries from burning which tended to become as serious as electric shock, and although the rate of increase in personal injury was not rapid the risk of fire caused by electrical faults had risen from about 5 per cent in 1925 to 18 per cent in 1953. Personal accidents and fires usually resulted from a short-circuit, an overload, or an earth. It was important to distinguish between these three forms of trouble because an automatic circuit-breaker, or a fuse, suitable for clearing heavy short-circuits might be unable to give proper protection against overload and earth faults. Almost any electrical accident or fire was evidence of failure to provide efficient automatic protection and the responsibilities in law were more far-reaching than was generally realized.

Good design of protective equipment could be nullified unless it was properly tested and maintained. The responsibilities of the electrical plant maintenance engineer tended to go beyond the duties associated with power and lighting. Many were being asked to look after electronic equipment and questions arose as to whether they should be assisted by specialized staff, train existing staff, or disclaim responsibility. However, electronics was not the only specialized application in factories and many plant engineers were concerned with electrical plant and processes which were confined to a particular industry and had their own kind of risk.

The three other discussion groups dealt with the application of work study and its incentives to plant maintenance, earth-moving plant, and the impact on the plant engineer of new engineering materials. In the evening the president and Mrs. Sievewright, together with the Mayor and Mayoress of Blackpool, received the guests at the conference dinner, at which the principal speaker was Sir Bruce White.

On Friday morning there were short reports by the discussion group leaders, followed by a brief debate on the replies received to a questionnaire on the implementation of the Productivity Report on Plant Maintenance. Mr. R. L. Marinello from Chicago then gave his impressions of the conference and the proceedings were wound up by Mr. Sievewright. After an informal leave-taking luncheon about 70 of the delegates visited the Preston works of the English Electric Co., Ltd.

I.E.E. London Students

The summer outing of the London Students' Section of the Institution of Electrical Engineers will be held on 2nd July when a visit will be made to the Romney, Hythe and Dymchurch narrow gauge railway. Particulars can be obtained from Mr. R. Hoseason, 218, Burrage Road, London, S.E.18.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Domestic Heat Pump

WE are naturally interested in the domestic heat pump, as a possible competitor with the use of solid fuel for water heating which we recommend. It seems, however, to us that the article on this subject in your issue of 6th May does not give a fair comparison of the costs of the two methods. In the first place, the price of the coke quoted 8s/cwt, is about the highest price for gas coke anywhere in the country (it is the Land's End price). A fairer figure would be 6s 9d, which is the top price in London, and above the national average. The weekly cost of water heating by coke would thus be 6s 9d over the eight colder months.

You assume that in the remaining four months an electric immersion heater would be used, at a cost of 11s 6d to give 400 gal/week. If the latter quantity of hot water is wanted—and we have long been arguing that the 150 gal often quoted is one arising only from the high cost of electric water heating—there seems no good reason why householders should not continue to use coke, at a weekly cost of only 6s 9d or less. Adding the 8d per week allowed by you for refrigeration, the weekly and annual running costs become 7s 5d and £19 5s 8d, respectively, leading, with depreciation and maintenance, to a gross annual cost of £28 17s 8d for the coke system, as compared with the heat pump figure of £34 3s 8d.

But is the latter cost realistic? If we understand you aright, it is claimed that the heat pump will supply 800 gal of hot water a week, all through the year, at a weekly cost of 4s 8d. What, however, is the position in winter when the natural air temperature in the larder is say 40 deg F? If the heat pump is abstracting large quantities of heat from a larder at this temperature (about 4,000 B.Th.U./hr to heat 465 gal of water) will not the larder be brought to an undesirable temperature of well below freezing point? To prevent this, will it not be necessary to shut off the heat pump (thus losing the refrigeration) and to use an immersion heater to produce the hot water? A few cold weeks would then bring the annual cost of the new system far above the suggested figure of £34 3s 8d. The system provides for a heated towel rail or an airing cupboard radiator as a heat leak when the heat pump is providing more hot water than is needed. These are attractive amenities, but it seems that they are likely to be in operation only when least needed, namely in the hottest part of the summer.

We do not wish to deny the use of the heat pump where large sources of "free" heat are available, but we do suggest that the possible difficulties in the operation of the domestic larder type need very careful study.

London, S.W.1. W. C. Moss,
Technical Manager,
Coal Utilisation Council.

[We regret that we were misinformed of the price of coke. At the lower figure the annual cost of the heat pump would be slightly more than that of the conventional system but the convenience would, we feel, outweigh this and, were it not for purchase tax, the heat pump would still be unquestionably more economic. The enormous number of households using immersion heaters in the summer do so surely because the demand for hot water is less and a boiler makes a kitchen too warm. Also habit and human nature incline against the routine of firing all the year round. The heat pump is understood to operate satisfactorily down to temperatures below freezing point and although abstracting heat from the air in the larder this is being constantly replenished by ventilators, from outside. The heat leak might reasonably be expected to operate during the night, throughout the year.—Editors, *Electrical Review.*]

Organization and Methods

IN your report of a recent meeting of the Royal Institute of Public Administration (" Organization and Methods "—6th May issue) you ascribe to me the words " antagonism or indifference of those at a lower managerial level."

I enclose a full transcription from the tape recording of the meeting in which you will see that neither the words " antagonism," " indifference," nor any synonyms of them, were used by me in my hypothesis. Reduced to its elements my question was, " How should a higher management, having formulated an O. & M. policy, express its policy to a *strong subordinate* management?" No other qualifications were used.

I would refrain, even in hypothesis, from attributing such unintelligent reactions to a modern management. Frank criticism or open scepticism are reactions which would more normally be expected. Harmful constructions could be placed upon your reporter's unfortunate choice of words which could damage my managerial relationships, and I would be grateful if you would publish this letter with the same degree of prominence as that accorded to the original report.

London, W.1. H. F. STEPHENS.

The Power Engineer's Status

I HAVE noted with interest the campaign of the Electrical Power Engineers' Association to improve the status of the engineer in the electricity supply industry.

How successful this campaign has been may be judged by two Electricity Board advertisements which appeared in your 13th May issue. The first post is for a district senior clerk, no qualifications stipulated, at a salary range of £870/960 per annum. The second post with the same Board is for a third assistant district engineer who should have passed the I.E.E. graduate examination, have experience in construction, operation and maintenance of high-voltage systems, etc., and be prepared to reside within the district to undertake standby duties—all this for a salary of £635/680 per annum.

" OBSERVER."

Industrial Art Bursaries Competition

The Royal Society of Arts has issued a booklet giving particulars of this year's Industrial Art Bursaries Competition, in which prizes amounting to £2,600 are offered. The prizes take the form of travelling bursaries, usually of £150 each, and are open to students who intend to take up industrial designing as a career. The closing date for entries is 10th October.

An exhibition of winning and commended designs in 1954 is being held at the Society's House, John Adam Street, Adelphi, London, W.C.2, until 28th May.

National Physical Laboratory

Some Recent Developments

LAST Friday the National Physical Laboratory again held an "open day" for representatives of industry, scientific and educational organizations and the Press to enable them to see something of the work in progress and the Laboratory's plans for the future.

The Mathematics Division now has not only the "ACE" digital computer, essentially a pilot model, but also the improved production model known as "DEUCE," already described in the *Electrical Review*. These machines have been particularly successful in problems involving matrices, such as the solution of algebraic linear simultaneous equations and the determination of latent roots. Schemes have been developed for the convenient evaluation of functions of matrices. Other problems easily handled include the determination of roots of polynomials and the solution of ordinary differential equations.

An extensive library of "sub-routines" has been built up. These are programmes for operations such as the evaluation of roots, powers, logarithms and other simple functions of a kind which occur in a wide variety of problems. Research is being carried out into the best methods of solving partial differential equations and other numerical processes for which adequate high-speed methods do not yet exist.

Servo-Simulator

A flexible electronic computer (a servo-simulator) has been developed and built by the Control Mechanisms and Electronics Section and is now available for the solution of problems submitted by industrial and other organizations. It can be used to study most systems which embody feedback and is thus particularly valuable for the analysis and synthesis of servo-mechanisms and process controllers. Its scope is by no means limited to this field and it has already solved problems on subjects as diverse as aircraft behaviour and the effect of controls on the national economy. In the machine the analogues of the various parts of the system, of any physical type, are set up in terms of resistance-capacitance networks and electronic amplifiers. A repetitive input of any required form can then be applied and the repeated responses at any point in the system shown as a steady trace on a cathode-ray tube.

The simulator works in a time scale which is a convenient ratio of the actual time scale in order that effects of changes in the parameters can be observed immediately. When a suitable solution has been obtained it may be plotted on a paper recorder at reduced speed without changing the set-up. A charge of about £12 a day is made for work carried out on the simulator.

In the Metallurgy Division a detailed study of the high-temperature creep and relaxation properties of steels from typical components intended for advanced operating conditions is being made; and comprehensive data have now been obtained for creep, rupture, and relaxation properties for times up to 10,000 hours. The components tested for creep and rupture properties include ferritic and austenitic superheater tubes and steam pipes, and ferritic cast steel of a type suitable for turbine casings. The whole of this work to date represents the most comprehensive collection of data of its kind available and is being extended to longer times than 10,000 hours.

There has been a rapidly increasing demand in recent years for heat insulating materials which can be used in equipment operating at low temperatures, such as quick-frozen food plant and high altitude aircraft, and in storage tanks and piping for liquid oxygen and probably, in the near future, for liquid-methane. It has therefore been necessary to find out how some of the heat insulators available in this country behave at really low temperatures. In the N.P.L. apparatus, the flow of heat is measured from a "hot" plate to a "cold" plate through the material; the cold plates are cooled either with liquid nitrogen down to about −195 deg C or with solid carbon dioxide down to about −75 deg C. Measurements have been made at lower temperatures than hitherto on fine fibred glass or mineral wool blanket, expanded plastics of various types, expanded ebonite and some lightweight powders.

In the high voltage laboratory an investigation which may have extensive applications in the future is that into the electrical insulating properties under pressure of a number of halogenated methane compounds and of sulphur hexafluoride. Data obtained have been compared with the electrical properties of nitrogen and of transformer oil at atmospheric pressure.

In the Electrotechnics Section a low-impedance standard current transformer for the ratio 0·25/5 has been developed. N.P.L. standard current transformers are constructed with mumetal cores having an initial permittivity of about 20,000 and with windings of about 5,000 ampere-turns at full load. These generally have a ratio error of less than one part in 10,000 and a phase angle of approximately 0·5 min and are suitable for all ratios down to 0·5/5.

For a ratio of 0·25/5 it is disadvantageous to operate with 5,000 ampere-turns, involving 20,000 turns on the primary, as this introduces errors due to the capacitance of the high-impedance winding greater than those caused by magnetizing current. A low-impedance type has recently been constructed using a core of special mumetal with an initial permeability of over 40,000 and having less than 1,200 ampere-turns. Features of the construction are the reduction of the inter-winding capacitance by an increase of insulation thickness between windings and reduction of the self-capacitance of the primary winding by dividing it into eight sections each wound on a separate part of the core. The sections are connected in series so that the voltage between adjacent sections is kept to a minimum.

Laboratory Heating System

Over the last fifty years the laboratory buildings have extended to cover about 65 acres of land and as each building or group of buildings has been erected a small boiler house has been provided locally. Recent investigations have shown that the base electrical load of the laboratory strikes a reasonable balance with the heating load and it has been decided to modernize the entire heating system by the installation of a 650 kW back-pressure turbo-alternator set. A new central boiler house plant is being built and work started in January this year. In the first phase of the work three 13,500 lb/hr Cochran "Sinuflo" economic boilers are being installed, with oil firing.

WORLD ELECTRICAL MARKETS

The Italian Position

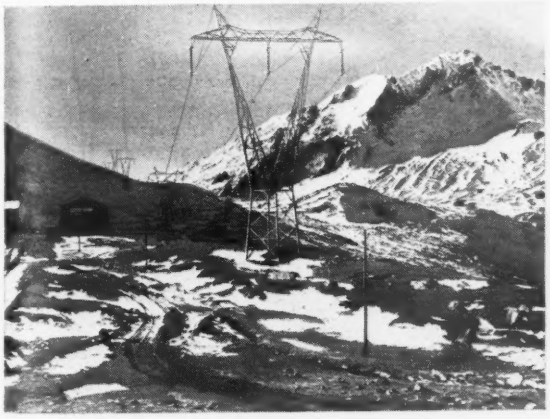
By DOTT. ING. ROBERTO CROCE (Rome)

AT 30th September, 1954, the effective capacity of Italian electric power stations was over 10 million kW, of which about 8 million kW was hydro-electric. In the first nine months of 1954 plant with a total capacity of 345,715 kW was put into operation in Italy; of this total, 33,000 kW was thermo-electric plant. Of the new plants, one totals 70,000 kW, two are of 37,000 kW each, one of 36,000 kW, and one of 18,000 kW.

The power produced between 1st January and 30th September, 1954, was as follows:—Hydro-electric, 30,700 million kWh; thermo-electric, 3,300 million kWh; geo-thermo-electric, 1,900 million kWh.

The reconstruction of the plants destroyed or damaged by the war and the construction of new plants was effected both through Italian home industries and through the importation of machinery from abroad (chiefly from the United States under E.R.P. aid to Italy).

Because of the pitch to which Italian electric power



A 220 kV interconnection with the French system crossing the Piccolo S. Bernardo

production has already developed large new construction projects are not to be expected, with the exception of one plant—still under preliminary study—for a total of 100,000-120,000 kW. As for the possibility of exporting British electric power production machinery to Italy, the following points should be borne in mind:—In the case of machinery and apparatus up to 60,000 kW, Italian industry is in a position to supply all requirements and therefore there seems to be no great possibility of importing foreign machinery. Theoretically there might be possibilities in the case of machinery and equipment for plants of 100,000 kW and over (should any be constructed). It should also be remembered, however, that some of the major Italian industries have obtained American manufacturing licences (Westinghouse and General Electric) for the construction in Italy of hydrogen cooled machinery of this type which would make the possibility of importing British machinery highly problematical.

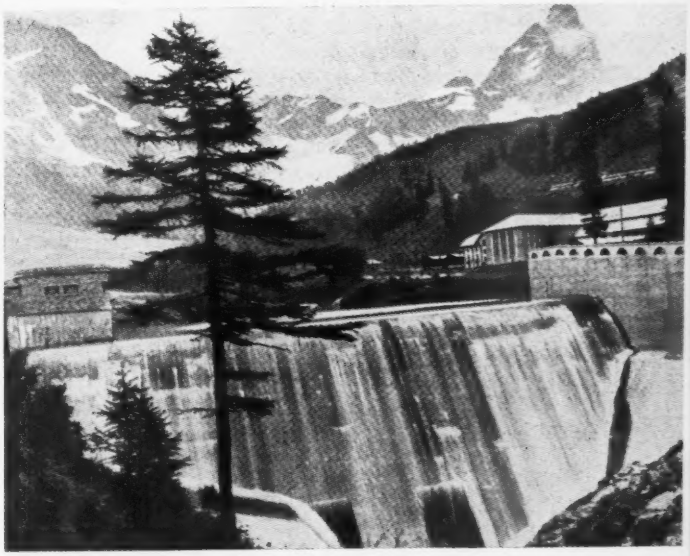
These considerations apply to conventional plants, i.e., plants equipped with hydraulic or steam turbines. The fact that the saturation point in the exploitation of the available water power is being reached has shifted the interest of engineers towards plants operated by thermal energy. In this field, the wisdom of avoiding the use of solid or liquid fuels (practically all imported) and of using the large and increasing amounts of methane available, has centred the attention of the constructors on this particular possibility. There is, in particular, an increasing interest in the possible installation of gas-turbine-operated generators, limited to cases where the power produced can be used locally. Because of the difference in the technical level between the British and Italian industries in this particular field, it is felt that this might possibly be an outlet for the exportation of British products.

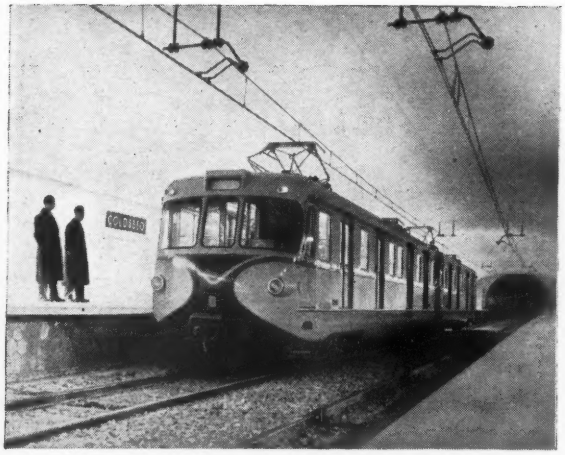
As regards the electrification of the Italian State Railways, the repair of damage caused by the war has already been completed and further development has also taken place. At 31st March, 1954, a total of 5,808 km was electrified, out of a total of 16,550 km of lines in operation. The systems employed are as follows:—3,000 V d.c. overhead collection, 4,469 km; 3,600 V three-phase a.c., 1,323·8 km; 800 V d.c. overhead collection, 15·2 km.

This reconstruction and development was carried out, in greater part, by Italian industry itself. This industry is in a position to supply all requirements of plant and rolling stock. It must also be remembered that the railways in Italy, with the exception of very few lines of a local character, belong to the State which, for obvious reasons of policy, limits its purchases abroad to the lowest possible amount.

Practically every branch of electrical manufacture is covered by the Italian electrical manufacturing industry

Dam at Perreres in the Valtournanche





One of the trains operating on the Rome underground railway opened in February last

which employs over 70,000 workmen and 20,000 office staff. The total annual production of the industry has a value of about £115 million sterling. The highest proportion of this is represented by cables and insulated conductors (18·5 per cent) with generators and motors (13·0 per cent) next in order.

The industry exports to a number of markets. Statistics for the first eight months of 1954 contain some interesting items. Generators, motors and rotary convertors (over 1,000 kg) to a value of 348 million lire (£1=1,750 lire) were sent to Russia, 276 million lire worth to Argentina, 243 million lire worth to Brazil, 171 million lire worth to France and 83 million lire worth to South Africa. The value of transformers over 1,000 kg exported to France was 987 million lire, to Australia 47 million and to Argentina 139 million.

Exports to the United Kingdom included generators, motors and rotary convertors (over 5 kg) to the value of 6·5 million lire and "fixed electric condensers" 6·4 million lire.

There was a substantial electrical import trade despite the ability of the Italian industry to meet most requirements. The largest item was generators, motors, etc. (over 1,000 kg) from the United States (1,048 million lire); imports of the same class from the United Kingdom were valued at 353 million lire. There was also an importation of smaller classes in this section of 82 million lire from the United Kingdom. Smaller amounts of several other classes of goods—including convertor and rectifier parts, control equipment, condensers and signalling equipment—were purchased from the United Kingdom.

As is well known, the importation of goods from the United States into Italy is subject to Government licence, whereas imports from the O.E.E.C. area are entirely liberalized. Owing to the strong negative balance of payments between Italy and the United States, licences for imports from the latter country are usually only granted when it is impossible to obtain machinery or equipment with the same technical characteristics from O.E.E.C. sources.

The biggest competitor of British industry is represented by the German Federal Republic. Italian preference for German goods is due to lower prices and much shorter delivery dates. Italian industrial circles have complained of the length of British delivery periods and, very often, of non-fulfilment of delivery promises.

The following suggestions may be made to British producers who are interested in the Italian market:—

1. Employ representatives (obviously only the capable and well-introduced type of man) because the purchasers usually want to have the supplier "within call."

2. Prepare publicity material, especially that of a technical character, in the Italian language.

3. Do not insist on excessively burdensome conditions of payment for Italian purchasers (for example, in the case of a product to be delivered after 6 or 12 months from the date of order, do not specify the opening of a credit for the whole sum to be made at the signature of the contract).

Electro-Deposition of Metals

PAPERS presented at the conference of the Institute of Metal Finishing on 17th and 18th May were summarized in the *Electrical Review* of 20th May. Those discussed on 20th and 21st May included one on electroforming in electronic engineering by Messrs. P. M. Walker, N. E. Bentley and L. E. Hall (British Thomson-Houston Co.). In the manufacture of microwave equipment, the authors stated, successful results depended on the preparation of stainless steel or of non-conducting, non-withdrawable material, the design of electrodeposition plant and the solutions used. Periodic reverse current gave good levelling and smoothing effects at fairly rapid rates of deposition. Germanium crystals were most suitable for current supply and electro-mechanical methods of current reversal were more reliable than electronic timers in plating shop conditions.

Most deposition in this field was carried out with copper and silver. An all-potassium bath of the cyanide type was very suitable, with mechanical rather than air agitation. Initial surface condition affected the final stress figure of subsequent electro-deposits, which was lessened by the use of periodic reverse current instead of normal d.c. plating. For silver cyanide solutions the concentration of carbonates over a wide range did not affect stress in the deposit.

The application of the electron microscope to the study of pigments and extenders, surface characteristics and internal structures of paints was dealt with by Mr. N. D. P. Smith (Imperial Chemical Industries), who also reported on surface changes during weathering.

An investigation into the barrel plating of cadmium on screw threads by Messrs. G. W. Wallbank and Dr. D. N. Layton indicated that the scatter of thickness on individual items increased with the average thickness of metal deposited and depended more on it than on any other single factor. A graph had been derived which showed the batch average to be aimed at to achieve any specified minimum individual thickness. Recommendations were made for rationalizing methods of specifying screw dimensions and plating thicknesses.

"Metal Finishing—Technique or Technology" was the title of a paper given by Lord Halsbury (National Research Development Corporation) against a background of the purposes of formal technical training and existing methods of achieving them. The good metal finisher, he said, was part chemist, part physicist, part metallurgist and part

engineer. In view of the needs of the community for functionally trained man-power, universities should be endowed with what *can* be afforded and technical colleges with what *must* be afforded. Education in technical colleges might well take the same general pattern of universities, which based a first degree on three to four years' whole-time study followed in 10 per cent of cases by a further two or three years of post-graduate study. The practice of technical colleges to get as close as possible to a three-year university degree standard in five years of part-time study would be inadequate for the future.

The author proposed a scheme of formal training, first, to provide the intellectual disciplines suitable for university degree courses in three to four years for scientists and five to seven years for research scientists and, secondly, to provide the functional studies involving components of sundry disciplines suitable for technical college courses of the same periods as above for technicians and for technologists. The level of expenditure on technical colleges was too low owing to lack of interest in what was taught or how or why by a public that cared mainly for the political aspects of education.

Three methods had been proposed by the Parliamentary and Scientific Committee to fill the gap between university engineering graduates and apprenticed craftsmen caused by an under-supply of properly trained technologists. These methods were, in the order considered most important by the author: expansion of selected technical colleges, which would be financed independently of the Ministry of Education and local rates; expansion of technological faculties at universities; allowing senior colleges of technology (Imperial College of Science, Manchester College of Technology and Royal Technical College of Glasgow) to break their present university associations (which they might not desire) and become independent educational establishments similar to the Massachusetts Institute of Technology. Insistence on the third method would be an obstacle to acceptance of the first, but the gap was so large that it called for the simultaneous pursuit of all possible means to a common end.

E.T.U. POLICY

Further Resolutions at Annual Conference

THE effect on the conditions of employment of manual workers of the reorganization being carried out by the London Electricity Board was discussed at the annual policy conference of the Electrical Trades Union at Worthing, the earlier proceedings of which were reported in our last issue.

Saying that the change to two-tier administration, with the abolition of Sub-Areas, would mean the re-siting of central and repair depots, Mr. C. Hamilton (London Station Engineers No. 12) contended that existing clauses of the National Agreement covering travelling time and meals out would be inadequate to deal with the new situation and hardship would result. On behalf of the Executive Council it was stated that time was needed to consider the matter and it was agreed that the motion should be referred to the Council.

A contentious topic in past years has been that of the "national rate," i.e., that the rate for London should apply to the remainder of the country, and once again there was a series of motions on the agenda relating to this question. Mr. F. Haxell, general secretary, said that, following last year's resolution on the subject, the Executive Council had decided to conduct research so that the Union would be in a position to base its policy not on assumptions but on facts. It was felt that Government statistics on wage rates were misleading when applied to E.T.U. members. In the past, the Union's policy had been based upon the difference between the cost of living in London and in rural districts. But he (Mr. Haxell) wanted very emphatically to say that there was no difference between London and the provinces in the price of food. There was a danger, he said, that some conflict between members in London and those in rural areas might arise, and there was a grave misunderstanding of the position of London members. Of the London wage rate 13s a week was for travelling time. This meant that the London differential was about 5s a week. There was a danger too of taking the question of a national rate to arbitration. If the award went against the Union, it would set conditions for all members.

On this statement six resolutions on the subject were referred to the Executive Council, but immediately after a similar motion was put to the conference. It recalled last year's decision that there should be a national rate not less than the London rate and proposed that efforts should be made to narrow the differential between the London and provincial rates of pay.

Mr. Denyer (Dorking) said the statement of the general secretary showed a considerable modification of previous policy. As to travelling time, provincial members also had to travel, sometimes large distances. Rents too were high in country districts.

On wage negotiations in the electricity supply industry, Mr. J. Humphreys said that the Executive Council, when negotiating wage increases, had always given consideration to the time lag from the start of the negotiations to final settlement. On the whole, the Executive Council was comparatively satisfied with the manner in which the Electricity Boards' representatives had negotiated wage claims with the unions.

A resolution—which was carried without opposition—urged the Executive Council to ensure payment of a full week's wage, in addition to sick pay to electricity supply employees who might be away from work because of an accident.

A composite resolution "viewed with concern" the continuation of the difference in conditions of employment enjoyed by clerical and administrative staff on the one hand and manual workers on the other. It requested the Executive Council "to do all in its power to secure for manual workers at least equality with other sections of the supply industry in matters of sick pay, holidays and superannuation." The mover of the resolution said that the time was opportune to initiate a drive to secure the objects sought for, and the resolution was carried without dissent.

A composite resolution urged the Executive Council to press for the linesman's rate of pay to be increased to the skilled rate. Mr. J. B. Glover (Frome) said the linesman was the "backbone" of the electricity supply industry; it was he who had to maintain the distribution system.

A resolution from the Cambridge Electronic Engineers'

Branch on organization in the electronics industry produced a lively discussion. It urged " the taking of immediate steps to secure a national wages structure for the industry that will ensure that the workers therein obtain some uniformity of reward, according to their skill, throughout the country." Mr. Murphy said the radio agreement of 1944 left the majority of the workers in the unskilled category. What was required was a national agreement that would reward the various classes of skill. An explanatory statement was made from the platform before the resolution was carried.

A motion that contained the threat of a strike was also carried. This requested the Executive Council " to take immediate steps to open negotiations with the Air Ministry Works Directorate for the purpose of eliminating anomalies at present existing in the wages and conditions of our members employed by them as electricians' mates." The anomalies were said to be concerned with payment for overtime and working after midnight. The resolution declared that " an energetic effort must be made to end this injustice " and failing a satisfactory outcome " stronger action should be employed."

Criticism of Nationalized Industries

The General Election forced the pace on Wednesday, the last day of the conference. Many items of importance were rushed through with, in many cases, complete unanimity. A long composite resolution on the nationalized industries, for example, did not bring out conflicting points of view. The Executive Council was urged " to pursue wherever possible policies which will change the present statutory obligations and financial and administrative structure of nationalized industries in such a way as to ensure that nationalization conforms to the purposes for which it was originally advocated." Finally, the resolution insisted that " the present relationships in the industries be reviewed with the object of giving the workers a greater degree of control."

All the delegates who spoke to the resolution condemned what was described as " the present set-up " in the electricity supply industry, joint consultation in particular coming in for heavy criticism.

There were two resolutions dealing respectively with the I.E.E. Regulations and an independent inspection council. Both were carried after a statement had been made from the platform. The first asked for the I.E.E. Regulations to be compulsory for all new installations; the second urged the Executive Council " to press for the setting up of an independent inspection council with full statutory powers to inspect and, when necessary, condemn any electrical installation." An amendment to the former motion suggested that "an independent inspection section" should be set up " within the Area Boards " and that the Union should " make representation to the Electricity Commissioners to incorporate the I.E.E. Regulations in the [Electricity] Act."

Mr. L. G. Gregory, for the Executive Council, speaking to the former motion and opposing the amendment, said the Executive had agreed to support an independent inspection body because of failure to secure statutory enforcement.

Conference carried a motion on redundancy in the electrical contracting industry. The resolution called on the Executive Council " to negotiate with the N.F.E.A. to establish the right of one working week's notice of dismissal in all cases of redundancy." A composite motion carried by conference urged the Executive Council " to do all in its power to inaugurate a sick scheme for our contracting membership in line with that operating in the supply industry."

Electrical Installation Contracting

First Meeting of National Inspection Board-Designate

IT is announced by the Organizing Committee for the National Inspection Council for Electrical Installation Contracting that, having discharged its terms of reference, it has handed over the responsibility for the establishment of the National Inspection Council to the National Inspection Board-designate. The Board-designate held its first meeting on 2nd May, when Mr. P. V. Hunter, C.B.E., was elected chairman. This body will proceed with the inauguration of the new Council with all possible speed and, as soon as this has been accomplished, it will function as the National Inspection Board set up as the executive body charged with the day-to-day business of the Council.

The National Inspection Council is to be established for the protection of consumers against faulty or unsafe electrical installations and appliances, and to this end it will set up a Roll of Approved Electrical Installation Contractors who shall have given evidence of their competency by conforming with the Rules and Regulations for the time being of the Council, and undertaken the responsibility required by the conditions of enrolment.

The National Inspection Council will be the sole judge whether the practice and experience in any particular case is sufficient to qualify. The broad qualifications which are considered to be desirable in applicants for enrolment as approved contractors are as follows:—(1) That the applicant should have had such technical training and practical experience as are necessary to give adequate service to the public; (2) That the applicant should possess suitable equipment and be of sound business and financial status.

Initially, any of the following will be admitted to the Roll:—Electricity Boards in respect of their Contracting Departments; members of the Electrical Contractors' Association; members of the Electrical Contractors' Association of Scotland; and certificate holders on the roll of the National Register of Electrical Installation Contractors.

Constitution of Council and Board

An initial membership of the Council of some 50 bodies is contemplated. Any requests for membership from organized national bodies will be sympathetically considered, as the view is held that the larger the number of interested national bodies represented on the Council, the greater will be the interest fostered in the work of the Council throughout the country.

The National Inspection Board will consist of 16 persons (with power to appoint a chairman and deputy chairman in addition) and the members so far nominated are:—

Central Electricity Authority: Sir Henry Self.

Area Boards: Mr. C. R. King, Mr. C. T. Melling and Mr. T. E. Daniel.

South of Scotland Electricity Board: Mr. J. Gogan.

Institution of Electrical Engineers: Mr. P. V. Hunter and Mr. Forbes Jackson.

Electrical Contractors' Association: Mr. J. C. Briggs, Mr. A. F. Plummer and Mr. L. C. Penwill.

Electrical Contractors' Association of Scotland: Mr. J. D. D. Shaw.

Association of Supervising Electrical Engineers: Mr. E. J. Sutton.

Association of Consulting Engineers: Mr. T. B. Rolls.

Electrical Trades Union: Mr. L. J. Gregory.

Electrical Power Engineers' Association: Mr. W. E. Fry.

A nomination has also been invited from the Royal Institute of British Architects.

Direct-Cooled Turbo-Alternators

Output Increased by Use of Hollow Rotor Windings

IT is well known that the output which can be obtained from any given turbo-alternator frame is limited by the amount of heat it is possible to dissipate from the rotor without the temperature rise of the windings exceeding the permissible limits. Any attempt to increase the output requires additional excitation power, with correspondingly greater loss and higher temperature rise unless at the same time modifications are made to improve the cooling. One such modification is the use of hydrogen at ½ lb gauge pressure in place of air as the cooling medium, and this not only increases the maximum permissible output but also the efficiency. Operation at increasing gas pressures allows greater outputs to be obtained but at a rapidly diminishing rate, as the possible improvement in heat dissipation is limited by the temperature gradients through the slot insulation and the rotor steel, which are unaffected by variations in pressure in the stator casing.

Another modification is to bring the cooling gas into direct contact with the copper of the rotor windings, so eliminating the two normally important temperature gradients just mentioned. This was proposed many years ago but had obvious disadvantages with air-cooled machines, while the increase in output would have been relatively small. With hydrogen cooling, however, conditions are more favourable; the possible gain is much greater and continues to increase as the gas pressure is raised. A number of machines using this principle have recently been built and while several different arrangements are used all appear to suffer from various disadvantages, such as discontinuous and unsupported insulation, high excitation current, uncontrolled gas distribution or limited heat dissipation surfaces.

The design described here and which has been developed by the General Electric Co., Ltd., not only provides efficient dissipation of the loss in the rotor windings but also a sound practical construction which has many advantages over the normal method of winding. It permits an appreciable reduction in frame size to be made and raises the maximum output of a single unit running at 3,000 r.p.m. to a figure in excess of 200 MW. The weight of the stator and the length of the set are reduced, and in most cases it is possible with direct cooling to use a rotor of a smaller diameter and this reduces the mechanical problems and facilitates the selection of suitable materials.

The essential feature of the G.E.C. direct-cooled alternator is the use of straight rectangular tubes for the slot portions of the rotor windings, which are ventilated on a separate circuit, the hydrogen being circulated through the tubes by a centrifugal impeller mounted on the outboard end of the rotor. The stator ventilation is substantially similar to that in a conventionally cooled design except that only one axial flow fan is fitted and the ventilation ducts are modified to suit the single end entry. The two parallel paths for hydrogen flow will be clear from the general arrangement drawing, Fig. 1, while Fig. 2 shows in more detail part of the windings at one end of the rotor, including the gas entry (or outlet) ports in the overhang portion. The slot tubes are connected at both ends by suitably shaped copper strips and these are also direct cooled on separate circuits which are not shown in Fig. 1. This increases the effective volume of hydrogen flowing through the rotor and reduces both the maximum and mean temperature rise of the windings.

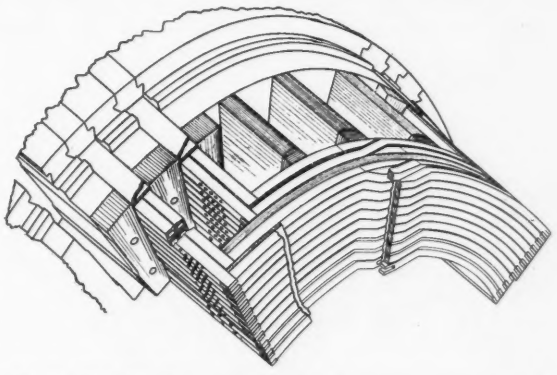


Fig. 2.—End view of two rotor coils, showing cross-connections, and gas ports in the conductors

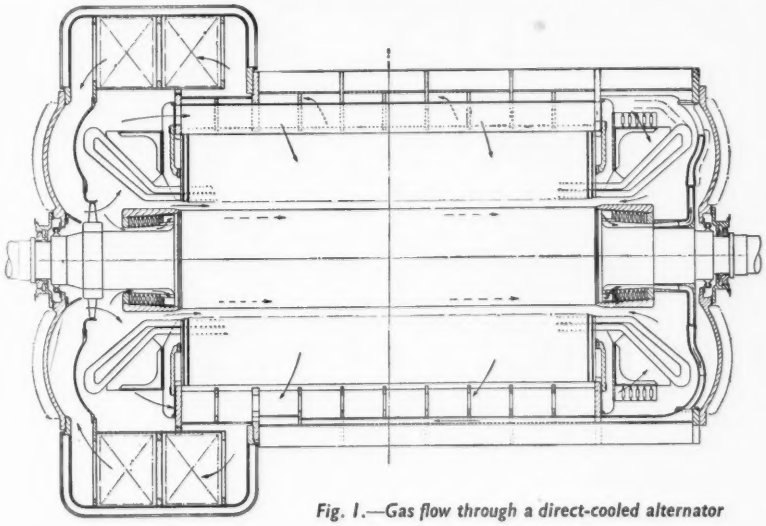


Fig. 1.—Gas flow through a direct-cooled alternator

The general arrangement of the conductors in the slots is shown in Fig. 3. The slot itself is parallel-sided and is wider at the top to provide the maximum area for copper and gas ducts. The conductors are hard-drawn tubes of electrolytic copper alloyed with a small proportion of silver in accordance with usual practice to increase the mechanical properties at elevated temperatures. As explained later this is not essential but is an

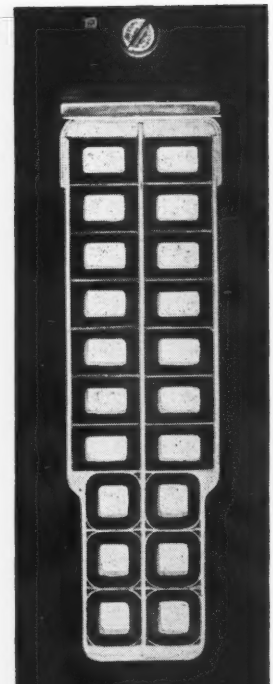


Fig. 3.—Arrangement of the conductors and insulation in a rotor slot

additional safeguard. The arrangement of two conductors side by side has the advantage that the number of turns per slot is not reduced compared with a conventional winding and the increase in excitation current is only moderate. At the same time, gas ducts of reasonably efficient aerodynamic shape are obtained and the mechanical stresses in the copper are low.

As will be clearly seen from Fig. 2, the end connectors are not tubular but consist of strips which are formed on steel jigs and, although clamped in position, the ends are machined to size so ensuring accurate assembly on the rotor and uniform support of the windings by the end bells. The conductors are fitted into the slots and the end-connected joints are made in a definite orderly sequence. The connectors are fitted to the bars at right angles, with an interleaved joint secured by silver soldering. This ensures that there is no distortion of the copper and no deterioration of the insulation, which is inserted after the joint has been made and as the winding proceeds.

One of the objects kept prominently in mind when developing the new winding construction was the possibility of eliminating micanite as the main insulation. Micanite has been used for a great many years and its general properties are well known, but it was felt that one of the more recently developed materials might overcome some of its disadvantages. The synthetic resin bonded glass cloth laminate used has high electrical and mechanical strength, a reasonable degree of flexibility, and is unaffected by temperatures well above those normally experienced in operation. The surface finish is smooth and hard and is well able to withstand frictional forces. In general, the insulation is used in a double thickness both to earth and as a separator in the centre of the slot.

The arrangement wherein the hydrogen is drawn from one end of the rotor to the other has many important advantages. It permits the use of continuous slot insulation with normal creepage surfaces, and eliminates any discontinuity or bushings, which are necessary if the gas is drawn in at each end of the rotor and discharged into the gap. Furthermore, the slot and interturn insulation is formed from rectangular strip material contained between continuous flat surfaces. The ports for gas entry into, and outlet from, the slot conductors are in the side walls of the tubes outside the rotor body as shown in Fig. 2, in a position where the metal is uninsulated. The gas flow, therefore, cannot be restricted by relative movement of the copper and the insulation.

The temperature rise of the stator is unaffected by the loss in the rotor windings since all the heat absorbed by the hydrogen passing through the tubes is carried direct to the inlet to the gas coolers. In view of the greatly increased excitation loss permissible with direct cooling, this is of particular importance. The cooling surface of the conductors exposed to the gas is large, keeping the temperature difference between the copper and the hydrogen to the minimum and rendering this factor relatively insignificant in relation to the mean temperature rise of the rotor windings. With the arrangement shown in Fig. 1, complete control is possible to equalize the volume of gas flowing through individual conductors. As the gas inlet temperature is also the same for all conductors, temperature from top to bottom of the slot is uniform.

On the practical side, in addition to the major advantage of pre-formed windings which can be assembled without distortion, there will be no local concentration of mechanical stress in the rotor wedges or teeth such as will arise with radial ducts discharging the gas into the gap.

Two complete rotor coils using full size copper sections were assembled and subjected to exhaustive mechanical tests. A steel jig, about one-third the length of a 60 MW rotor, was fabricated to support four rotor slots and into these the two complete coils were wound using the specified conductors and insulation. Advantage was taken of the opportunity to develop a suitable winding technique, but very few problems arose and the second coil was wound and insulated in a remarkably short time.

When the winding was completed, the model was transferred to the G.E.C. Witton Laboratories and a massive clamping arrangement was fitted to compress the conductors in the slots, so simulating the effects of centrifugal force. The load on the clamping bolts was measured by individual strain gauges, totalling over three dozen, so that complete control of the loading was possible. The windings were connected to a low voltage, heavy current d.c. supply and a suitable blower was erected to draw air through the conductor tubes.

After preliminary tests had been made, automatically controlled thermal cycling was applied to the windings, the temperature of the copper first being raised rapidly to a value much above the operating conditions with no cooling on the model. Then the current was interrupted and the blower run to cool the copper in the shortest possible time, the temperature of the copper being checked along the length of selected bars by thermocouples built in as the winding proceeded and also by means of voltage tappings on other bars from which the resistance and mean temperature could be calculated. Since in the model the end connectors are not ventilated they eventually reach a higher temperature than the tubes and a measurement of the average temperature of the whole winding is not sufficiently accurate.

The duration of the thermal cycle is about 15 minutes and since it is running night and day the time multiplier even for a machine on two-shift operation is of the order of 1:100. The thermal conditions are, of course, much more severe since in no power station will full load excitation suddenly be switched on to an unloaded machine. Periodically, the insulation is examined for signs of deterioration, but up to the present none has been found; the tests are proceeding on a long-term basis and with higher temperatures in order to establish operating limits.

The reduction in frame size means increased loading of the stator. Tests on conventional alternators carrying overloads up to 33⅓ per cent, which correspond with the normal loadings proposed for direct-cooled machines, have demonstrated that stators of standard design will be entirely satisfactory. Units embodying direct cooling with outputs of 60 MW and 120 MW are now in course of construction at the company's Witton Engineering Work.

Mauritius All-Island Scheme

Ten-Year Development Programme

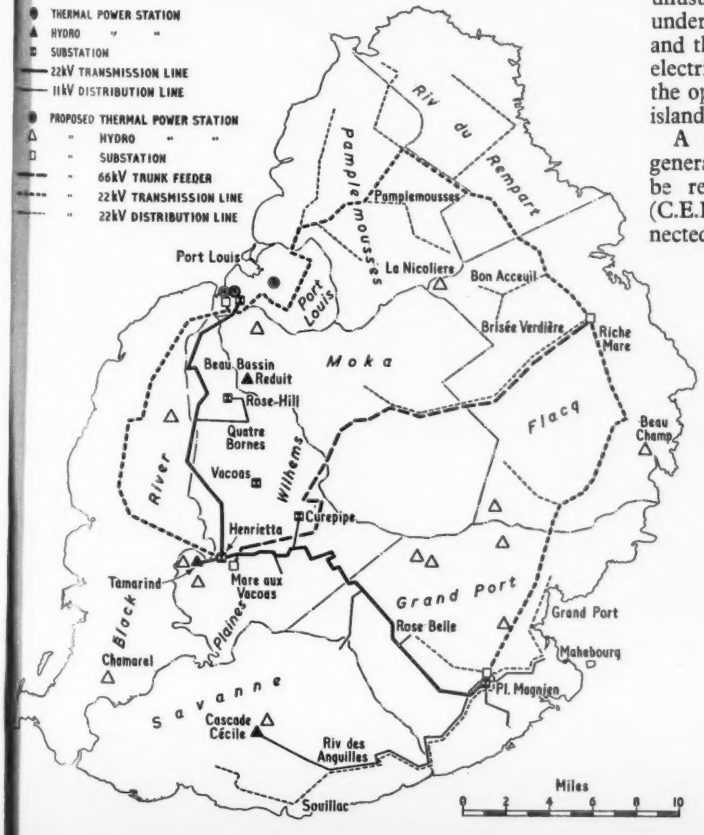
SET up in December, 1952, following a report by Messrs. Preece, Cardew and Rider, the Central Electricity Board of Mauritius has now formulated a ten-year development programme. This provides for an all-island scheme of transmission and distribution integrated with the existing supply systems. Mr. A. N. Bott, M.I.E.E., the Board's general manager and formerly city electrical engineer of Winchester, tells us that a point of special interest is the intention to make extensive use of aluminium alloy conductor. For service connections to premises it is proposed to employ twin plastic cables.

Mauritius, which lies east of Madagascar in the Indian Ocean, is 719 square miles in extent, 80 per cent of which has not yet been developed electrically. Some 315,000 out of the total population of 515,000 live in this part of the island. To cater for the colony's immediate needs it is proposed to augment the diesel generating plant, but for the future the fullest possible development of the water power resources is considered essential to economic electrification. Because conditions are not ideal for water storage—the island is described as resembling an inverted bowl the sides of which fall with a fairly steep and uniform gradient to the sea—it is proposed to adopt a system of combined hydro-electric and thermal generation, using the latter for base-load purposes in the dry season.

In carrying out its plan the Board is confronted with a number of problems. Although the population density is fairly high, the purchasing power of the inhabitants is limited and much effort will be needed to educate the public in the use of electricity. Another factor is the absence of industrial load, the island's principal industry (sugar) having its own source of power in the form of bagasse. There is the possibility that a more profitable use might be found for this product, such as in paper making, in which case additional electric power might be required. Lastly, the most remunerative part of the island, between Curepipe and Port Louis, is served by a private company, the General Electric Supply Co., which in 1953 took over the former Rose Hill undertaking of the Mauritius Hydro-Electric Co. In Port Louis itself, an unusual situation exists for although the former municipal undertaking was taken over by the Government in 1939 and the system is now operated by the Board, retailing of electricity remains in the hands of the municipality. In the opinion of the Board, sooner or later the whole of the island's system should be brought under a single authority.

A table shows that last year 35 million kWh was generated by the two authorities but load shedding had to be resorted to. Sales amounted to 29 million kWh (C.E.B., 12 million) and the number of consumers connected was 32,820 (C.E.B., 18,110), giving an average consumption per consumer of 890 (C.E.B., 695). By 1962 it is expected that the total output will rise to 100 million kWh for the whole island and the number of consumers to 56,060, with an average consumption of 1,460 kWh.

The main station on the island is the hydro-electric plant of the G.E.S. Co., at Tamarind, the firm power available from which is limited by irrigation requirements. In 1953, to meet the acute shortage, the C.E.B. decided to build a diesel station at Plaine Lauzun, near Port Louis. The first stage, now under construction, will comprise four 1,750 kW Mirrlees-Brush sets and if neces-

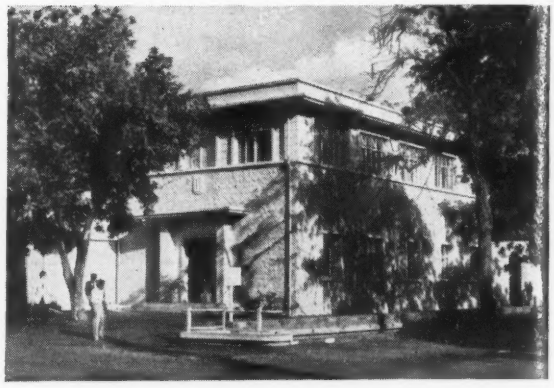


Above: The Central Electricity Board's new diesel station. Left: Map of the present main transmission and proposed 22 kV transmission and three-phase distribution systems (22 kV single-phase lines not shown). Probable or possible hydro-electric developments are indicated

sary it will be possible to develop the site to a total capacity of 20,000 kW. As soon as the second set is in commission the existing diesel stations at Bell Village and Poudriere Street will be closed down. The degree to which the Port Louis station is extended will depend upon the development of hydro-electric power. The plant capacity required in 1962 is put at 29,000 kW and the Board's proposals provide for an additional 16,000 kW to be obtained from water power.

The Board has decided to adopt 22 kV as the standard transmission voltage and to construct a line in the form of a ring main round the island, of which the existing Port Louis-Curepipe-Plaisance line will form a part. A 66 kV transmission line across the island is also visualized, but this is not likely to be required during the ten-year period.

For the complete all-island scheme some 10,000 to 15,000 concrete poles will be needed and the Board proposes to set up its own plant to manufacture these at Plaine Lauzun. The complete transmission and distribution system will consist of 64 miles of 22 kV three-phase transmission lines, 265 miles of 22 kV three-phase and single-phase distribution lines, and 149 miles of lower voltage lines. The report also discusses commercial policy and tariffs. In a foreword the chairman of the Board, Mr. A. René Adam, looks forward to a higher standard of living as a result of the plan.



The head office of the Board at Port Louis

Human Relations in Industry

THE annual general meeting of the Institution of Electrical Engineers was held on 19th May. After the proceedings had concluded Lord Citrine gave an address on "Human Relationships in Industry." There were, he said, no experts on this subject who could provide a ready-made solution to the problems which arose. The trade union movement, while not the cause of industrial unrest, was largely the medium through which that unrest was expressed, and might be said to have three main objectives: adequate remuneration, security of employment, and a measure of control in the industries in which the workpeople were employed.

Remuneration was one of the most common causes of strikes, something on which negotiation was perpetually going on. He did not believe that it was possible to get rid of the problem; he could only hope that by education, by full disclosure of the affairs of great public and private organizations, and by discussion with the workpeople affected, it would be possible to get a better sense of proportion and more knowledge of the factors involved and so narrow the area of dispute. Arbitration might be received with more readiness when the limitations within which it was possible to settle adequate wages and conditions of employment were fully realized.

Governments now seemed able to secure full employment, but what was in the mind of most trade unionists, particularly in regard to the use of restrictive practices, was a doubt whether this state of affairs could last.

A measure of control might be of even more basic importance to the workers than remuneration and security. The principles of joint consultation were now commonly conceded by individual employers and by Government policy. Monetary incentives of themselves were inadequate, and even in the United States the system of payment by results was falling into disuse. Differential bonus schemes had never proved a lasting solution, nor had profit-sharing and co-partnership schemes, while they had their place, furnished a permanent remedy.

The community could not hope to keep millions of workpeople contented and happy without giving as much attention to human relations factors as to economic and technological factors, and this was a primary responsibility of management. What part did engineers play in this? He had been impressed, in his eight years of contact with the electrical industry, by the fact that men of first-class engineering experience, with good, logical brains, never seemed to have concerned themselves with this part of managerial responsibility. More and more industry would look to fill the higher managerial posts not primarily from people with good technical training but from those with broad minds, a human outlook and an understanding of men, and they would look for qualities of leadership.

Joint consultation did not mean the impairment of the powers of management. Some unions had made the extravagant claim that joint consultation meant the sharing of executive responsibility but it had been possible to convince them that the Electricity Boards could not shed their exclusive responsibility under the Act. Of late there had been evidence, however, that the claim was being resuscitated.

Confidence in management came mainly by carrying out promises and by encouraging subordinates to express themselves freely without fear of the consequences. Management must be clear about the policies which it was expected to carry out, and that often exposed a weakness in internal organization. One of the mistakes made in attempting to promote joint consultation had been to by-pass the foreman.

Many people believed that welfare schemes were devised solely to provide more efficient production, but any scheme which did not take into consideration the status of the workman as a human being was likely to fail. "I believe most firmly," Lord Citrine said in conclusion, "that industry has a real responsibility for producing good and contented human beings. I do not believe that it is possible to have a happy and intelligent and contented general community and at the same time a suspicious and discontented industrial community."

Engineering in Europe

Abstracts from Foreign Technical Journals

IT is claimed that high explosives for shot-firing have lately been developed which combine absolute safety in firedamp or coal-dust atmospheres with remarkable strength. It was also possible to design electric detonators of a comparable safety in dangerous atmospheres. The problem of achieving fullest safety in shot-firing is thus reduced to rendering the power source and supply circuits equally safe under the severest conditions, i.e., intrinsically safe.

Where the power source is concerned, whether of the d.c. or a.c. generator type, or batteries charging capacitors, this means, among other things, reduction of voltage and current as well as duration of the firing current to safe limits. However, especially in multiple-shot firing, the reduction must not go too far because of the risks of misfiring. This part of the problem has also been solved satisfactorily because of the experience available with other types of mining electrical equipment, flameproof and explosion-proof machinery, etc. The most difficult point is therefore the elimination of any possibility of sparking in the case of short circuits or interruption of the firing circuits or supply circuits.

The relation between the requisite low inductance, minimum resistance and possible short-circuit current is rather complicated. Experiments have shown that the margin within which such circuits may be regarded as intrinsically safe is very narrow if alternative dangers, e.g., misfiring, are also considered. Apart from this, certain types of breakdown of the supply source may still imply dangers of firedamp ignitions. Research work on this important problem is still proceeding.—" Intrinsic Electric Safety in Shot-Firing," E. Wehner, *E.T.Z.(A)*, Vol. 76, No. 7, pp. 248-250, 1st April, 1955, in German.

Strength of H.V. Porcelain

Ceramicists responsible for the design and production of h.v. insulators are aware of the relations between the residual structural and thermal internal stresses in the porcelain, and the ageing of ceramic materials, which have been extensively investigated. Not so clear, however, are the effects of the considerable dynamic service stresses, particularly those of a sign-changing or vibratory character, sometimes even of impulse character, on the ageing process of technical ceramics. The problem consists of separating the effects of service stresses from those due to production processes and thermal treatment, and also from those simply due to the particular structure of the product, e.g., to the glaze. Such investigations were carried out in a test set-up producing symmetrical bending stress cycles at acoustic frequencies. The specimens were porcelain bars.

It was found that the bending strength decreases linearly with the logarithm of the number of stress cycles down to a certain limit (fatigue limit) and then remains constant. The number of cycles after which this limit was reached was the same for the two types of porcelain tested, viz., $1{\cdot}5\times10^6$. This value is called the " cyclic service life." It is not affected by an increase of the annealing temperature of the porcelain, but such an increase reduces the fatigue limit, i.e., the ultimate value of the bending strength.

Two of the usual glazes (white and brown) were found to reduce the fatigue limit and static bending strength of the porcelain, whereas another glaze improves these characteristics. In general, the " cyclic service life " of glazed poreclain is longer than that of unglazed porcelain. The experimental relation between fatigue limit and static bending strength may be expressed thus:—

$$\sigma\gamma = 0{\cdot}7\sigma_{stat} - 14\ [kg/cm^2].$$

—" Effect of Sign-Changing Loads on the Mechanical Strength of H.V. Porcelain," N. G. Drozdov and Yu. S. Chatinyan, *Elektrichestvo*, No. 2, pp. 32-36, 1955, in Russian.

Overstressing Line Insulators

An elaborately equipped experimental station set up on a dead-end tower of a 150 kV line has been in operation for several years and furnished comprehensive data on the actual stresses on overhead line insulators in service in alpine regions and under severe meteorological conditions. The bulk of the data available has now been evaluated and enables the imperfections and errors of previous measurements to be rectified. This is done in a very systematic and exhaustive way and the same kind of critical analysis is carried out for the methods and instruments used in the authors' investigations. Relations between additional temperature rise (i.e., non-electric) of the conductors and conditions of insulation are derived from a comparison of actinometric and temperature measurements and used for establishing the actual form of the relationship between conductor temperature and mechanical stresses transmitted to the suspension.

Owing to the fact that a close collaboration of all the meteorological stations of the region had been obtained, very complete information on wind, precipitations, storms, snow and ice conditions could be used for the investigations concerning the influence of these factors on the conductor stresses. The conventional form of the relation between wind speed and inclination angle of the insulator strings could be replaced by a more reliable one. Of great interest is the introduction of the concept of the efficiency of a wind setting up a certain pressure.—" Investigation of the Mechanical Overstressing of Overhead Line Insulators in Normal Operating Conditions," P. Schuepp, L. Gion and J. Deberon, *R.G.E.*, Vol. 64, No. 2, pp. 83-103, February, 1955, in French.

Insulator Testing

Among the methods of non-destructive testing of insulators, ultrasonic tests based on the impulse reflection principle have lately gained in importance, although their use is restricted to the porcelain bodies only, thus to homogeneous specimens, and does not extend to the composite metal-porcelain product represented by the insulator ready for service. X-rays, on the other hand, can penetrate such

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

bodies, but their penetration depth depends on the energy of the radiation and the conventional industrial X-ray equipment operating with energies up to about 300 keV would be limited to penetration depths of about 10 cm in iron.

The development of modern particle accelerators has fundamentally changed this position, since commercial types of accelerators, particularly betatrons, have now extended the energy range of X-rays available to 31 MeV which is obviously much more than just sufficient for the purpose indicated. The use of these extra hard and penetrating rays not only enables the thickest composite structures to be penetrated, but also simplifies the tests, since the exposures required are very short, no screening and filtering is required and no special precautions against stray radiations need be taken. As a consequence, the determination of the mechanical test loads in relation to service and breaking stresses can be put on much more reliable foundations, which means that the mechanical tests themselves can be rendered non-destructive (this obviously excluding type tests).—"Non-Destructive Testing of Insulators by X-Rays Generated by Betatrons," H. Baatz and G. Reverey, *E.T.Z.(A)*, Vol. 76, No. 5, pp. 195-197, 1st March, 1955, in German.

Contractors and Employees' Negligence

Apportionment of Responsibility

By F. E. SUGDEN

I HAVE always contended that an employer is liable for injuries to an employee if he is responsible for the accident which caused them but that he is not liable if the accident is brought about by the negligence of both the employer and employee or the employee entirely. However, it has recently been decided in the Courts that a contractor is liable if he employs a semi-skilled employee who causes an accident to another employee who is himself either semi-skilled or fully trained.

Before setting out the case I should like to quote the ruling in another case that an employer is under certain obligations to his employees to provide for their safety. He may delegate the carrying out of such obligations but he cannot delegate or avoid his own responsibility for their proper performance. So, if the person left to carry out such an obligation is negligent in carrying it out and that negligence causes injury to a fellow servant, the employer is liable in damages. One of these obligations is to provide a safe system of working, which must be judged in each particular case.

In the case I have in mind, the law regarding proportionate damages was stated, and it was also ruled that the standard of care owed by an employer to workmen in his factory for the purpose of determining his liability to them for negligence was higher than the standard to be applied in determining whether there had been contributory negligence on the part of one of the workmen.

The plaintiff was employed by the defendants to erect a generator and had to rely on a crane for the lifting of the machine. Attached to the crane was a main hook from which hung four chains. The men on the floor, of whom the plaintiff was one, hooked the chains on to the generator. It was their duty to see that the main hook was centred over the load. The crane driver, who was not fully qualified but was also employed by the contractor, should have paused but did not pause, when beginning the lift, to see that the load was centred and hanging vertically. The load swung out and the plaintiff, an electrician, was injured, and he sued the defendants for damages for negligence.

The Court held, that on the facts, the crane was negligently handled by the crane driver and the plaintiff was at fault in not having centred the main hook over the load as should have been done by the men on the floor. The defendants were responsible for the negligence of the crane driver as if it were their own act but the standard of care owed by a workman was less than that owed by his employers and in the present case the plaintiff's fault was an error of judgment not amounting to contributory negligence. Accordingly he was entitled to recover damages without any share of the responsibility for the accident being apportioned to him.

In coming to this decision the Court stated that because the crane driver was semi-skilled, as distinct from the electrician who was fully skilled, the contractor should not have delegated any authority to him for the using of the crane. As a consequence, because the crane driver was partially responsible, the Court awarded proportionate damages to the injured workman at the rate of 5 per cent.

Whilst I am on the subject of negligence I should like to draw the attention of contractors to another case decided by the Courts: the particulars are as follows:—

Electrical contractors agreed with the occupiers of a factory that two of their employees should work at the factory on certain electrical installations. The contractors continued to employ the men, paying their wages, stamping their insurance cards and retaining the sole right to dismiss them. The electricians worked exclusively at the factory, used the canteen there and conformed to the hours of work observed in the factory. They were supplied by the occupiers of the factory with all materials, tools, plant and equipment, except for certain special tools which were their own property, and their work was supervised by a foreman employed by the occupiers, who required the men to follow practices customary at the factory instead of those of the contractors.

One of the electricians was injured through a piece of defective plant. The Court held that the occupiers of the factory and not the electrical contractors owed the injured electrician the common law duty of an employer to his employee to provide proper plant and equipment and therefore were liable to him for breach of that duty.

I mention this case because many concerns regularly employ men from electrical contracting firms. This is the case, for instance, in the Temple, London, where there is an electrician constantly employed owing to the age of the buildings; he is provided by independent electrical contractors.

Comprehensive Lighting Change-Over

LIVERPOOL'S £600,000 SCHEME

THE Liverpool City Lighting Department (engineer, Mr. C. C. Smith, A.M.I.E.E.) is carrying through a scheme for the complete electrification of the city's street lighting. It will involve the removal of some 11,000 gas lamps and the erection and commissioning of approximately 15,000 electric lamps in their place at an estimated cost of £600,000. In certain parts of the city, in fact all outside the central area, the work is to be completed within ten years, while the work inside the central area is to be kept abreast of development and completed within 15 years.

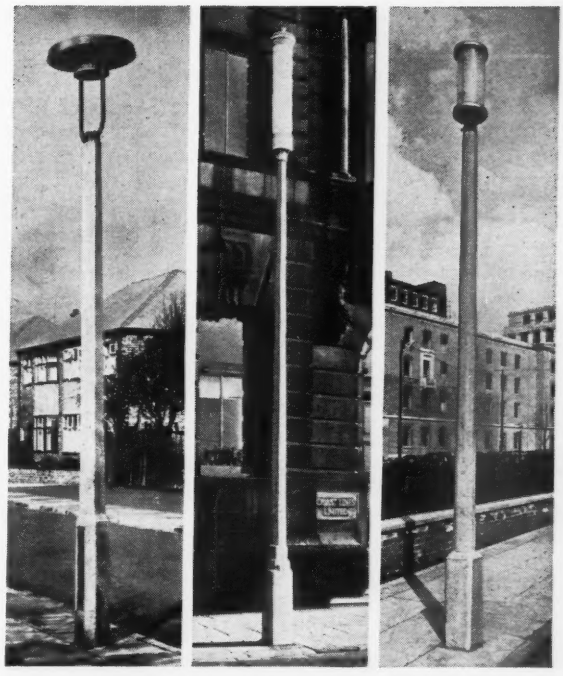
The scheme will not only provide for the conversion of the existing gas lighting to electricity but will also allow for considerable improvement, especially where mounting heights and spacings are poor by modern standards and also where roads require lighting to group "A" instead of group "B" standards. It may well be that some of the existing electrical installations will require "re-electrification" when compared with newly converted gas areas.

Very broadly, the installation can be divided into three general categories:—(1) main roads; (2) residential roads; and (3) special situations. The first two are covered in the main by group "A" and group "B" lighting referred to in the Ministry of Transport's Departmental Committee report. The third category includes places where lighting of a rather special nature, usually from the decorative or æsthetic point of view, is required or desirable and probably rather more expensive equipment is, perhaps, justifiable. Situations of this type, for which modern lighting has already been approved, include Castle Street (main approach to the Town Hall), Otterspool Promenade and, most recently, the Pier Head. It is considered that lighting with special decorative effect can do much to make the city more attractive and pleasant, particularly for strangers and visitors by night.

The "Critchley" wall lantern

With regard to the lighting of main traffic routes and residential roads, the committee and the lighting engineer feel they cannot improve on the sodium cut-off installation for the former, and "Highfield" brackets and "Critchley" wall lanterns for the latter, all of which are well tested and proved units of equipment.

Our Liverpool Correspondent has been informed that the Merseyside and North Wales Electricity Board was approached to quote an all-in average figure for electricity, possibly, in view of the immensity of the scheme, a little lower than that now being paid, but its reply was to the effect that the present basis of charging, by which all lamps over three yards from a main distributor are considered individually and charged extra accordingly, was considered to be quite satisfactory. It is difficult in such circumstances to estimate what service line costs may be, but under this arrangement service lines for lamps on new housing estates are averaging £12 per lamp and in recent conversions carried out in gas areas, rather more, which suggests that Liverpool must allow at least £12 per position, as against £3 paid before nationalization.



Left to right: The "Highfield" column; cold cathode lantern as used for the Pier Head; and the "Terrace" column

Conference of Standards Engineers

WELL over 100 engineers concerned with the application of standards in some of the most important industrial organizations in this country met recently at British Standards House in London, under the joint auspices of the B.S.I. and the Institution of Production Engineers.

Conferences of standards engineers have frequently been held in the United States and have long proved their worth in providing a forum for the exchange of views and discussion of the best ways of applying standards to increase production and secure the economic benefits which they are designed to give. The enthusiastic response of our own standards engineers showed that they were very ready to take advantage of a similar opportunity, and it was no surprise when, at the end of a full and stimulating day, they decided that such conferences should be held regularly, envisaging the next one in six months' time.

The main themes of the conference were discussion of the general problems of standards engineers in industry and consideration of the method of presentation of British Standards, with ways in which this might be improved to be of greater service to those who use them. It was agreed that the status of the standards engineer should never be in doubt, nor should he have to "sell" standards to his company. The economic importance of standardization and simplification in industry had been stressed by the Lemon Committee on Standardization of Engineering Products, which was set up shortly after the war to investigate means of aiding productivity. The Board of Trade, when issuing recommendations based on the report of this Committee, had stated that the task of implementing them should be in the hands of senior and responsible company officials.

London's Electricity Supply

MR. D. B. Irving's paper on "The Supply of Electricity in the London Area" (see *Electrical Review*, 20th May) was discussed at a meeting of the Supply Section of the Institution of Electrical Engineers on 18th May. Mr. Forbes Jackson, who opened the discussion, said that in 1914 Charles Merz, in a report to the L.C.C., recommended the establishment of a new undertaking with power to amalgamate all the various undertakings. The maximum demand in London was then about one-fifteenth of what it was to-day, and the total capital expenditure under £30 million. During his twenty years with the L.C.C. the speaker had been able to negotiate with one borough electrical engineer a special tariff for a special job, and then go to the next one and say "I have got this from so-and-so." By that means he had got all the undertakers to agree to a common policy for housing. The public had expected uniformity of tariff structure to result from nationalization, and he thought the L.E.B. had not done enough about that.

Mr. J. W. Leach expressed the view that prices for electricity could be lower if engineers were allowed complete freedom to get on with the job. He mentioned, as means to this end, peak-load relief by gas turbines, which could be installed in abandoned generating stations; supervisory automatic control of load, to give better utilization of plant; and assigning a life of 50 years to cables and distribution plant generally. The modern l.v. network was more or less standard, but methods of injection from h.v. systems varied. The Sub-Area system had served the industry well and great care should be taken before modifying it radically at a comparatively early stage.

Mr. B. Donkin (Kennedy & Donkin) referred to the newer type of gas-pressure cable with an aluminium sheath. He believed that the main advantage of the aluminium sheath was that it needed no reinforcement as lead sheaths did.

Mr. L. H. Welch (L.E.B.) remarked that there were more different tariffs in London than different systems, so that whatever engineers had to reproach themselves with, other people had even more.

Use of Old Plant

Mr. H. V. Pugh (London Division) said that the aggregate capacity of the London power stations was now nearly 4,000 MW. In the last three complete years 1,000 MW of new plant had been installed, and they seemed to have kept abreast of the demand in London and the surrounding districts; 40 per cent of the kWh they generated went to the surrounding districts. During the last spell of cold weather, at many power stations every piece of plant had been available and capable of carrying about its maximum load, although in some cases it was 50 years old. If the load factor of some of this old plant was round about 5 per cent there was no economic reason why it should not go on operating for ever. Three or four years ago the old Bankside station generated 100 million kWh a year; in the last full year that had dropped to 30 million. That seemed to be the pattern for the older stations. Owing to smaller output of these the thermal efficiency of the London stations in the aggregate was now 25 per cent.

Mr. R. R. H. Taylor (C.E.A.) said that a large proportion of the 40 per cent of the power generated in London stations but used outside the L.E.B. area went to the west of London, where a large heavily loaded area had few adequate generating station sites. The policy of the Central Authority was to produce the cheapest overall scheme, irrespective of whether the cost fell on the Authority or on the Area Board, and in this the L.E.B. co-operated harmoniously.

Mr. H. I. Kenner (L.E.B.) criticized the interleaved system on the grounds that cables and transformers had to be installed earlier than was necessary and that local load conditions at the time of load saturation were difficult to forecast. The absence of sectionalizing facilities on the h.v. distributors was operationally unsound, and a large amount of spare plant must be available on adjacent distributors to prevent prolonged interruptions of supply. The transformer units described by the author, however, seemed an excellent method of avoiding the high costs of building and equipping a conventional transformer chamber, and the network protection did away with the need for a circuit-breaker. There seemed, therefore, to be a case for a synthesis of the two methods of h.v. distribution, interleaved and standard, combining the transforming economy of the one with the flexibility and cable economy of the other.

The author stated that loads of 200 MW/sq mile were expected within fifteen years in some areas. Plant and cable now being commissioned would have a life of 50 to 60 years. Had the author an estimated figure of the load density to be expected near the end of the century, when present-day equipment would still be useful? Even with a load density of 200 MW/sq mile as a minimum, 533 500 kVA transformers and $5\frac{1}{2}$ main substations would be required per sq mile, indicating the expediency of immediately installing transformers of 750 kVA rating as the best average value.

Future Load Density

Mr. W. Holttum (B.I.C.C.) said that the method of installing cable on hooks above ground seemed to be meeting in some quarters with unmerited disfavour, and asked what the future policy would be if the alternative were available of installing cables below ground.

Mr. L. H. Fuller (S.E.E.B.) expressed gratification at the adoption of the outdoor style of substation. The old practice of providing very nice buildings, costing anything up to £400 each, represented in the aggregate a very considerable capital expenditure.

The author, replying to the discussion, emphasized the difficulty of tariff standardization in an area where there had been 270 different published rates at vesting day. Where differences existed on opposite sides of the same street, he said, it would cause a tremendous upheaval if tariffs were rationalized overnight. He sympathized with Mr. Leach's view that prices should be lower, and the aim of the Board was, if not to lower them, at least to prevent them rising further. An important advantage of the two-tier organization was that the engineer would reach a managerial position in his thirties or forties. With the size chosen for the new type of District, the District manager would be able to manage it personally in a way impossible for the Sub-Area manager.

The pressure cable with the aluminium sheath had been examined during the first year or two for corrosion and no sign of trouble had been found. There had been a solid system in London for nearly 30 years. Moreover, on vesting day they had found a solid d.c. network of 20 MW, which was later split into smaller sections.

GENERATION AND DEVELOPMENT

Electricity Sales

The accompanying table analysing electricity sales is the first to be issued by the Central Electricity Authority in continuation of the monthly press statements issued by the former British Electricity Authority concerning the progress of electricity supply. The figures for April and all earlier periods relate exclusively to England and Wales and are not comparable with the previous returns which applied to Great Britain less the North of Scotland district. They show kWh sold by the Authority and taken by the Area Boards for their consumers.

The national figures indicate an increase over April, 1954, of 8·4 per cent, but when corrected for weather conditions and working days (26·59 against 26·81 in April, 1954) the increase is 11·8 per cent.

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for April (million kWh)			Twelve Months Totals Ended 30th April (million kWh)		
	1954	1955	Inc. or Dec. %	1954	1955	Inc. or Dec. %
London	479·4	489·2	+ 2·1	5,749·2	6,293·6	+ 9·5
South Eastern	292·7	308·5	+ 5·4	3,432·4	3,787·8	+10·4
Southern	334·5	367·9	+10·0	4,025·5	4,557·1	+13·2
South Western	168·7	190·9	+13·2	1,978·5	3,358·0	+19·2
Eastern	463·5	489·6	+ 5·6	5,567·8	6,193·1	+11·2
East Midlands*	382·3	420·7	+10·0	4,738·8	5,321·2	+12·3
Midlands*	522·4	562·1	+ 7·6	6,370·2	7,102·4	+11·5
South Wales*	308·4	344·2	+11·6	3,646·8	4,098·7	+12·4
Merseyside and North Wales*	295·3	335·1	+13·5	3,584·6	4,122·3	+15·0
Yorkshire*	509·9	553·8	+ 8·6	6,215·2	6,894·2	+10·9
North Eastern*	304·5	323·6	+ 6·3	3,719·5	4,053·8	+ 9·0
North Western*	569·3	600·0	+ 5·4	6,954·5	7,598·6	+ 9·3
Total all Area Boards ...	4,630·9	4,985·6	+ 7·7	55,983·0	62,380·8	+11·4
Direct Supplies by Central Authority	94·3	135·2	+43·4	1,032·7	1,472·4	+42·6
Grand Total	4,725·2	5,120·8	+ 8·4	57,015·7	63,853·2	+12·0
Mainly Industrial Areas* ...	2,892·1	3,139·5	+ 8·6	20,753·5	23,189·6	+11·7
Mainly Non-Industrial Areas	1,738·8	1,846·1	+ 6·2	35,229·5	39,191·2	+11·2

* Those in which industrial consumers took over 50% of the total sales in the preceding financial year.

Historic Water Wheels

After more than one hundred years of continuous service, two famous water wheels have turned their last and will no longer provide power for the D.P. Battery Co., Ltd.'s factory at Bakewell in Derbyshire. Earlier this year a breakdown caused extensive damage and it has been reluctantly decided that repairs would be impracticable. The wheels are therefore to be dismantled and replaced by a modern water turbine.

The larger wheel dates from 1827 when it was installed to provide power for a cotton mill. Built by the Manchester firm of Hewes & Wren, the wheel measures 25ft in diameter by 18ft wide and has 70 buckets around its circumference, each capable of holding half a ton of water. Under normal working conditions the total weight of water in the buckets was about 10¾ tons. To carry such a weight, the wheel would have had to be of massive structure if the power were to be transmitted through the spokes and axle. A series of teeth were therefore arranged around the inner circumference of the wheel so that they engaged with a pinion situated just below the point at which the water entered the buckets. The weight was thus applied almost directly to the strong pinion wheel nearly 5ft in diameter and 1ft 2½in wide, which operated the shafting in the mill. The smaller wheel, dating from 1852, was built by Kirkland & Son of Mansfield and measures 21ft in diameter by 7ft wide. The output of the two wheels together was between 60 and 80 kW.

Since the D.P. Battery Co., Ltd., took over the then disused cotton mill in 1898, the water wheels have been producing electricity used in the manufacture of storage batteries. Apart from their obvious usefulness for producing power, they have been of great sentimental value and during the last nine years £8,000 has been spent on repairs and replacements.

The breakdown was caused by one of the teeth on the large wheel fracturing and jamming against the pinion. This resulted in many more teeth being stripped from the wheel and many of the cast-iron segments being broken. All the pinion wheel teeth were torn away and finally, the frame of the water wheel itself and of the driving wheel in the works cracked under the strain.

The two historic water wheels outside the D.P. Battery Co.'s premises at Bakewell. On the left is the 1852 wheel and on the right the larger 1827 wheel. In the right foreground can be seen some of the segments removed after the breakdown earlier this year

Southern Area Topics

Meeting at Reading on 17th May with Group Captain J. C. M. Hay in the chair, the Southern Electricity Consultative Council welcomed Mr. R. R. B. Brown and Mr. S. M. Rix, the new chairman and deputy chairman of the Board, and also Mr. Willott Taylor, chief engineer, and Mr. K. L. May, mains engineer, who had been invited to report to the Council on their visit to Ireland in connection with the possibility of reducing the costs of rural supply schemes.

The Council noted with appreciation that the Board had acceded to its request that wherever farmhouse and farm buildings take a supply the premises should be treated as plural and in consequence be required to return 15 per cent gross revenue rather than 20 per cent as required for single premises connected.

After further consideration the Council accepted the Board's reasons why the domestic tariff could not be applied to old people's and children's homes, etc. The Board pointed out that concessions had already been made in respect of bedrooms and private sitting rooms in all premises to which the standard commercial tariff applied. There were two methods of dealing with the problem, namely, that adopted by a neighbouring Board of charging the commercial tariff in full for premises over 4,000 sq ft and the domestic tariff for premises under that size; and the Southern Board's method under which premises irrespective of size attracted only ten primary kWh per room for bedrooms and private sitting rooms and an installed load assessment elsewhere.

Summing up his report on the visit to Ireland, the Board's chief engineer, Mr. Willott Taylor, said that nothing had been found which would lead to any substantial reductions in the cost of services to isolated premises in rural areas but the following might lead to some reduction:—(a) Increased use of aluminium should now be considered for the smaller l.v. schemes where compression connectors could be used; (b) the pressing forward of investigations in order to produce a satisfactory aluminium connector for a 0·1 sq in (copper equivalent) conductor; and (c) the use of larger spans with wider conductor spacing for long single-phase l.v. services.

Tenders for House Wiring

Reading Town Council has been recommended by its Finance and General Purposes Committee to accept the tenders of the Southern Electricity Board—the third lowest for each contract—for the wiring of pre-war houses. The tenders are £1,545 for 96 houses on the Shinfield Road and £7,681 for 450 houses on the Oxford Road housing estate.

The report of the Council says that the second lowest tenders have since been withdrawn, leaving one tender in each case lower than that of the Southern Electricity Board. "We have been informed of the reasons which prompted the Housing Committee to accept the tenders of the Board instead of the lowest tenders," the report states.

Electricity in the Dales

Lord Aberdare and several other eminent people have protested in *The Times* against the erection of overhead lines in Borrowdale and Patterdale in the Lake District. They consider that underground cables should be used and that the extra cost of these should be a national, not a local, charge.

Midlands Change-Over

Of the 74,000 consumers of the Midlands Electricity Board who were receiving d.c. supplies when the Board was established in 1948, no fewer than 58,000 have been changed over to a.c. and it is hoped to change over the remainder within the next two years, said the deputy chairman of the Board, Mr. D. P. Sayers, speaking at Stafford on 20th May. The change-over was completed last week in Stafford, and Mr. Sayers was speaking at a staff dinner which followed the switch-off of d.c. supplies. Mr. Sayers said that a still bigger task remained in Stafford, for the h.v. distribution system there was 6·6 kV and it was hoped in due course to change over to 11 kV, which would mean more power available to meet the ever increasing demand for electricity. The estimated cost was upwards of £170,000 and it would take five years to complete. Mr. Sayers paid a tribute to the work of the manager, Mr. J. G. Kellie, and the staff of the Board's Stafford District, which, he said, now had almost 16,000 consumers, compared with just over 8,000 in 1948, while in the same period annual sales had increased from 35 to 92 million kWh.

South Wales Rural Electrification

In the financial year ended 31st March last 1,311 farms (in addition to a large number of other rural premises) were connected to the electricity system in the area of the South Wales Electricity Board. This is the highest number of farm connections yet achieved in one year and compares with a figure of 951 for the previous year. It is estimated that capital expenditure on works to provide supplies in the rural areas of South Wales will amount during 1955-56 to £1,300,000. Of this total, an estimated sum of £400,000 will be devoted to the erection of new h.v. lines and the balance of £900,000 will be spent in providing supplies to individual consumers and localities. The average consumption by farmers in South Wales amounted to 3,440 kWh per annum in 1953-54 but this rose in 1954-55 to 3,608 kWh.

Transport Costs

Commenting on the plan of Huddersfield Corporation to stop the trolley-bus services to Brighouse, Councillor H. C. Nobbs said at a meeting of Brighouse Borough Council that it seemed astonishing that on one side they had a Corporation which thought that motor-buses were cheaper to run than trolley-buses, while on the other side of the town the opposite view was taken by Bradford, where trolley-bus services had been reintroduced because they were cheaper than petrol buses.

Cheaper Electricity in N.S.W.

On 8th May the chairman of the New South Wales Electricity Commission, Mr. H. G. Conde, forecast further reductions in bulk power charges next year. This follows concessions at the beginning of the present year. Announcement of the cuts was likely in September, he said. Mr. Conde was addressing the annual conference of representatives of more than 100 municipalities, shires and county councils which distribute electricity. He said the Commission's financial position had improved because of modern generating plant and new power stations.

Mr. Conde announced that the Commission planned to install additional plant totalling 750,000 kW by 1960. This would increase the generating capacity by 75 per cent. Major stations at which the plant would be installed were Tallawarra, already in partial operation, Lake Macquarie, and Wallerawang. The first units would be operating at Lake Macquarie and Wallerawang next year.

So far, plant with a capacity of 120,000 kW had been ordered for both Tallawarra and Wallerawang. Lake Macquarie would have a capacity of 330,000 kW. These three stations would become the major base load stations in the southern, western and northern regions. By 1962, however, plant to generate another 350,000 kW would be installed. The main units would be two 100,000 kW generators for Tallawarra and two 60,000 kW generators for Wallerawang. The 100,000 kW generators would be by far the largest in Australia. They would be similar to those being installed at Castle Donington and Willington in Great Britain.

Kariba Scheme Decision

An immediate start is to be made on the Kariba hydro-electric scheme on the Zambesi in Southern Rhodesia. The Salisbury correspondent of *The Times* says that this results from a report by two French consultants who were asked to examine the project. Tenders are to be called for in the next two or three weeks for the construction of a diversion tunnel and the first concrete coffer dam. It is hoped that this early start will mean that the first power will be available in 1960—a year earlier than was originally expected. The French report says that the information now available justifies preparations for the calling of tenders for the main engineering work and plant.

Power Policy in Argentina

Referring to complaints about the shortage of electric power in Argentina, President Peron stated recently that Argentina's hydro-electric works were situated far from the centres of industry and could provide only a local or a long-term solution. At present, the country had to rely on thermal power and 60 per cent of her fuel needs had to be imported. It was necessary to increase the production of the country's oil industry and foreign firms had been called in to assist with the exploitation of Argentina's oil resources. The electricity companies had been persuaded to invest in oil-burning equipment.

Electricity in Nigeria

Our Lagos correspondent reports that the outer walls of the new power station at Ijora have now been completed and inside the new building contractors are installing the four steam boilers and the two 12,500 kW turbo-alternators which will more than double the amount of electricity available in the Lagos area.

Poland's Power Output

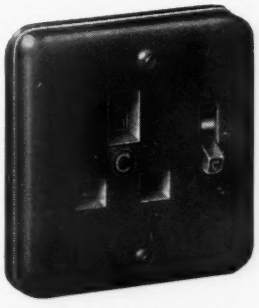
In 1954 more than 15,000 million kWh was produced in Poland. During the last ten years, the Polish authorities claim, over 14,000 villages have been connected to the national grid. Within the next year Polish industry is scheduled to produce the first 25 MW turbo-generator and a high pressure boiler.

NEW ELECTRICAL EQUIPMENT

Range of 13 A Outlets

A new range of eleven flush and surface mounting 13 A socket-outlets is being introduced by J. A. CRABTREE & CO., LTD., Lincoln Works, Walsall. Switched and unswitched patterns are available and both shockproof (brown or cream finish) and metal plate units in a variety of finishes are listed.

Thought has been devoted to the new range to make it easier to wire and to ensure enduring service after installation, the connection of conductors to the terminals being a particularly easy task. On the metal units the plate is of the "raised" type, providing considerably more wiring space than can be given by flat plate accessories; and on all units the switch has a moulded nylon dolly which is virtually unbreakable. The shield guarding the socket-outlet openings is formed of flat fibre and is operated



Crabtree flush 13 A outlet

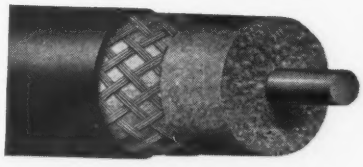
through a nylon cam by the earth pin, the mechanism being lightly spring loaded.

The range is designed to harmonize with "Lincoln" a.c. flush switches, and will enable a matched installation to be provided.

Television Downlead Cables

A new range of television downlead cables incorporating cellular polythene insulation has been introduced by BRITISH INSULATED CALLENDER'S CABLES, LTD., 21, Bloomsbury Street, London, W.C.1. They have been developed in order to meet the problem of the increased cable attenuation which occurs at the higher frequencies at which commercial television will be operating.

The range of B.I.C.C. solid polythene-insulated cables introduced some years ago specifically for television downleads has proved completely satisfactory for all reception conditions associated with Band I frequencies. The development of Band II (frequency-modulated sound) and Band III (television) broadcasting, however, introduces new problems arising basically from reductions in anticipated signal strengths and increased losses in the aerial downlead. The attenuation or loss of signal strength in any cable is approximately doubled when changing from 50 Mc/s to 200 Mc/s.



Cellular polythene cable for television downleads

In general, attenuation can be reduced by increasing cable dimensions or by the use of alternative materials as the dielectric. Research has shown that cellular polythene provides the most effective and practical alternative since it has a very much lower dielectric constant than solid polythene, although its electrical characteristics, such as dielectric loss and insulation resistance, are comparable. Also, the attenuation values are comparable with those of semi-airspaced cables, without their inherent susceptibility to the ingress of moisture.

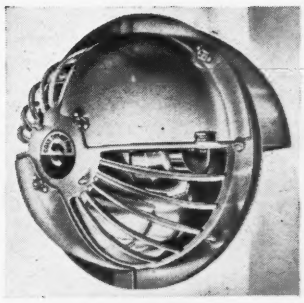
Redesigned Water Heaters

A change in the design of type UDB "Sadia" electric water heaters is announced by AIDAS ELECTRIC, LTD., Sadia Works, Rowdell Road, Northolt, Middlesex. The new loading will be 1 kW (instead of 500 W) at the top, plus 2 kW (instead of 2½ kW) at the bottom. The number of elements will be reduced from six to three, one on the upper plate and two on the lower plate, and will be withdrawable and interchangeable. The new upper element plate assemblies will not fit earlier models, but spare element plates of the old design will fit old or new types.

Two-Way Fan

A window ventilating fan providing inlet air and extraction simultaneously has been placed on the market by COLT VENTILATION, LTD., Surbiton, Surrey. The fan achieves this dual purpose owing to the fact that it is mounted on a solid plate which divides the air stream and is fitted in the window glass with its axis at right angles to the plane of the glass.

When fitted, the fan is enclosed in a sphere which has four opening ports, two in the top section above the dividing plate and two in the bottom. A rubber gasket is provided for fitting the inner and outer halves of the sphere to each side of the window. An outer weather-shield is fitted and when required the whole unit can be completely sealed up by means of two shutters.

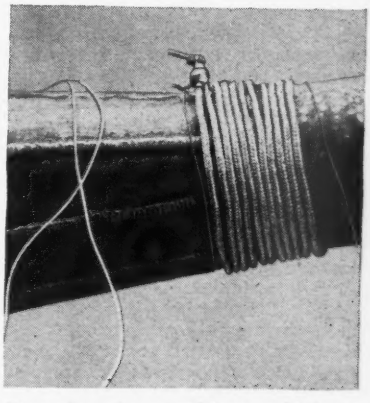


Colt two-way fan

A single phase, 50 c/s motor suitable for use on a 200/250 V supply is used and consumption is in the region of 25/26 W. The overall diameter is 12½in and the impeller measures 9in. The unit is finished in polychromatic old gold and is priced at £19 10s. A box of six air cleaning filters can be supplied as an extra at £1 1s 6d.

Armoured Heater Cable

As an efficient mobile method of preheating and stress relieving in welding, ELECTROTHERMAL ENGINEERING, LTD., of 270, Neville Road, London, E.7, have introduced armoured heater cable which can be wound round most pipes and vessels with ease and can be operated from a welding generator or other suitable power source. For the most satisfactory operation thermal insulation of sectional asbestos, magnesia lagging or asbestos tape should be clipped or tied in place over the heater. As an example of performance the medium powered unit applied to a 9in diameter steel alloy pipe with a ⅜in wall thickness raised the temperature from 12 deg C ambient to 700 deg C in 45 min. Thermocouples, pyrometers, etc., can be supplied for use with the equipment.



Electrothermal armoured heater cable in use

Financial Section

STOCKS and SHARES

TO-DAY (Friday) will no doubt see a swirl of activity in the Stock Exchange as reactions to the General Election result begin to work their way out. In advance of the event, it was thought that the response would be modified or exaggerated, as the case might be, by the sanguine manner in which industrial share prices went ahead (until checked by the strike troubles) during the weeks preceding polling day. As the accompanying price lists show, many of the popular electrical equipment shares figured prominently in that advance.

Cable Shares

With the 1954 results of most of the principal cable manufacturing companies now published, the impression is left that trading conditions during the year were at times more difficult than was the case in some other branches of the electrical industries. In the annual reports of W. T. Henley's, Telegraph Construction and Johnson & Phillips, however, there are indications of improvement as the year progressed, and in some sections a good volume of current orders. On the average, trading profits have been reported at around the previous year's levels, or rather below. Dividends from the large groups are mostly unchanged, and in no case is there any sign of difficulty in maintaining former rates.

Outlook

In his statement accompanying the Automatic Telephone & Electric Company's annual report, Sir Alexander Roger reports that sales of telephone equipment in 1954 were again limited by Treasury restriction, and notes with satisfaction that increased capital expenditure will be available to the Post Office. In overseas markets the forward outlook is described as encouraging. The chairman of the London Electric Wire Co. & Smiths said at the recent meeting that it was too early to forecast results for the current year, especially in view of uncertainties over copper and the Monopolies report, but he looked forward with quiet optimism.

Telephone Results

In maintaining the ordinary dividend for 1954 at 10 per cent, the rate paid also on the five previous occasions, Telephone Manufacturing propose a 20 per cent scrip issue and report a net profit of £133,000. The latter is £22,000 under the previous year's figure, but well above the general level of previous years. It leaves the distribution on the £750,000 capital covered more than three times over. Hall Telephone are also maintaining the succession of 10 per cent ordinary dividends. In the report, which shows little change in the net profit at £21,000, the present year is said to have opened with a co-

The Week's Price Changes

Company or Board	Nom. Value	Middle price 23rd May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	84⅛		3	3	3 11 0	94¾	84½
Brit. Elec. 1974/77	100	84⅛		3	3	3 11 0	93⅞	84½
Brit. Elec. 1976/79	100	88½		3½	3½	3 19 0	98¾	87½
Brit. Elec. 1974/79	100	100½		4¼	4¼	4 4 6	109	99½
Overseas Electric Supply								
Calcutta Elec.	£1	22/-		6†	6†	5 9 0†	22/6	20/9
East African Power	£1	23/-	+1/-	7	7	6 1 9	23/3	19/9
Nigerian Elec.	£1	23/6		10	10	8 10 3	27/-	22/6
Palestine Elec. "A"	£1	21/-		Nil	Nil	—	22/9	21/-
Perak Hydro-Elec.	£1	18/-		6	10	11 2 3	21/-	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	13/-		12½	17½	6 14 6	13/9	11/-
Aerialite	1/-	6/6		88½	88½	—	6/7	5/3
Allen, W. H.	£1	77/-		15	20	5 4 0	81/6	77/-
Aron Elec. Ord.	£1	61/3		20	15	4 18 0	62/-	55/6
Assoc. Elec. Ord.	£1	72/6	+5/-	11½	14	3 17 3	72/6	65/3
Automatic Tel. & El.	£1	72/-		15	15	4 3 4	79/6	69/-
Babcock & Wilcox	£1	76/3	+2/6	12*	15	3 18 9	81/6	68/6
Baldwin, H. J.	2/-	4/9		20	20	8 8 6	5/4	4/4
Bakelite	10/-	29/6	+9d	12½	16	5 8 6	32/-	27/-
British Aluminium	£1	45/6	+6d	10	12	5 5 6	46/-	35/3
B.I. Callender's	£1	49/-	+2/3	10	10	4 1 9	55/3	44/9
B.I. Callender's 6% Pref. ...	£1	25/-x.d.		6	6	4 16 0	26/6	24/-
British Thermostat	5/-	25/9	+9d	35	27½*	—	27/3	22/6
British Vac. Cleaner	5/-	17/-	+6d	25	30	8 16 6	17/9	14/3
Brook Motors	10/-	40/-	−1/3	20	20*	—	42/9	39/9
Brush Ord.	5/-	8/9		6	10	5 14 3	9/6	7/7
Bulgin, A. F.	1/-	6/-	+9d	30	45	7 10 0	6/-	4/-
Burco	5/-	18/9		35	25*	6 13 3	23/-	18/9
Chloride El. Storage "A" ...	£1	70/-	+1/3	12½	17½	5 0 0	70/9	58/6
Clarke Chapman	£1	85/-	+2/6	20	20*	4 14 3	85/-	68/9
Cole, E. K.	5/-	21/-	+1/-	25	27½	3 5 6*	24/6	18/3
Cossor, A. C.	5/-	9/9	+3d	10	10	5 2 6	11/3	8/9
Crabtree	10/-	30/9		17½	20	6 10 0	34/6	29/3
Crompton Parkinson Ord. ...	5/-	17/3	+6d	20	20	—	19/9	16/-
De La Rue	5/-	24/-	+6d	Nil	20	4 3 3	24/3	18/9
Decca	4/-	38/-	+3/6	35	56¼*	—	45/6	31/-
Desoutter	5/-	27/9		20	25	4 10 1	28/-	25/6
Dewhurst	2/-	8/6	+6d	19	24	5 13 0	8/6	7/3
Dictograph Tel.	2/-	7/3	+3d	20	20	5 10 3	7/6	6/6
Dubilier Condenser	1/-	5/-		25	25	—	5/7	3/10
E.M.I.	10/-	30/6	+2/6	8	10	3 5 6	37/-	25/3
Electrical Components	5/-	15/9		20	20	6 7 0	17/6	15/3
Elec. Construction	£1	36/3	+2/6	15	15	4 2 9*	37/3	31/6
Enfield Cable Ord.	£1	20/-		Nil	Nil	Nil	25/3	20/-
English Electric	£1	68/9	+5/-	10	12½	3 12 9	69/3	54/3
English Electric 3¾% Pref. ...	£1	15/6		3¾	3¾	4 16 9	16/9	14/9
Ericsson Tel.	5/-	39/6	+1/6	25†	20†*	2 10 9†	39/6	29/-
Ever Ready	5/-	29/6	+2/6	40	35*	5 18 9	29/6	22/3
Falk Stadelmann	£1	47/6	+1/3	15	15	6 6 4	50/6	43/9
G.E.C. Ord.	£1	60/-	+2/6	11½	12½	4 3 3	61/9	51/3
G.E.C. 6½% Pref.	£1	27/-		6½	6½	4 16 3	28/4	23/6
General Cables	5/-	15/9		30	30	9 10 6	17/-	15/9
Greenwood & Batley	£1	55/-		17½	17½	6 7 3	57/-	54/6
Hackbridge Cable	5/-	17/3		20	20	5 16 0	17/9	14/-
Hackbridge & Hewittic	5/-	24/6		20	25	5 2 0	28/9	23/9
Hall Tel. Acc.	10/-	13/3		10	10	7 11 0	13/9	11/-
Heatrae	2/-	4/6		12½	12½	5 11 0	5/9	4/3
Henley's	10/-	18/-	+3d	10½	10½	5 16 9	20/6	17/-
Holophane...	5/-	17/6x.d.		20	25	7 2 9	19/9	16/-

* After scrip issue. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

siderably increased order book and prospects of a growing turnover.

Elliott Bros. Capital

Over the past year or so, the 5s shares of Elliott Brothers (London) have been reflecting increasingly active investment interest in the possibilities opened up by the latest types of electronic computers, process control and associated instruments. Accounts for 1954, now published by the company, confirm an expansion in the consolidated profit (after tax) to £108,000. Current business is stated to be good, and the board hopes to see a further improvement in earnings, although not perhaps at the rapid rate of the last two years. At the meeting on 2nd June the chairman expects to deal with the question of raising fresh capital to finance the continued expansion of business. At 42s 6d the 5s shares have been standing lately about mid-way between this year's extremes of 48s 9d and 34s 6d. Dividend for 1954 is equivalent to 16·6 per cent on the present capital of £462,000.

...in Electrical Investments

Company or Board	Nom. Value	Middle price 23rd May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1955 High-est	1955 Low-est
Equipment and Manufacturing—continued.								
Hoover	5/-	47/-		45	70	7 8 10	52/6	40/-
I.C.I.	£1	47/-	+2/6	15	10*	4 5 1	47/6	38/3
Intl. Combustion	5/-	20/9x.c.		20	25	—	20/9	16/3
Johnson & Phillips	£1	44/6		15	15	6 14 9	52/6	45/-
Lancashire Dynamo	£1	62/6	+1/3	14	15	4 16 0	62/6	55/3
Laurence, Scott	5/-	15/9	+3d	20	12½*	3 19 3	16/9	14/6
Lister, R. A.	£1	34/6		12	9·3*	5 7 9	38/3	30/6
London Elec. Wire	£1	57/-	+4/-	10	12½	4 7 9	61/-	50/6
Lucas, J.	£1	46/3	+2/6	10·8	7½*	3 4 9	50/6	41/6
Marryat & Scott	2/-	9/6		22½	25	5 5 3	10/4	9/6
Mather & Platt	£1	63/-		15	13·4*	4 5 3	63/-	48/-
Metal Industries	£1	35/3	+1/3	12	9	5 2 3	38/-	30/-
Midland Elec. Mfg.	£1	48/9	+1/3	15	10*	4 2 0	48/9	44/-
Morphy-Richards	4/-	32/6	+3/-	40	35*	4 6 3	32/6	27/-
Murex	£1	53/9		15	15	5 11 6	57/-	49/3
Newman Ind.	2/-	2/9		10	10	—	3/6	2/4
Oldham & Son	1/-	3/6		17½	17½	5 0 0	3/6	2/10
Parnall (Yate)	5/-	10/6x.d.		8	14	6 13 3	13/2	7/3
Parsons, C. A.	£1	80/-	+3/9	7½	10	2 10 0	80/-	56/-
Plessey	10/-	71/3	+2/6	30	20*	2 16 3	76/6	57/6
Pye Deferred	5/-	35/-		20	20*	2 17 3	40/6	28/6
Revo	10/-	13/-		27½	9*	6 18 6	15/3	12/6
Reyrolle	£1	105/-	+7/6	13¾	15	2 17 3	106/3	89/-
Rheostatic	4/-	11/3		20	22½	—	11/3	9/3
Richardsons Westgarth	5/-	13/9		15	15*	5 9 0	15/-	11/-
Scottish Cables	4/-	19/9		20	27½	5 11 3	22/6	19/6
Smith (England), S.	4/-	18/6	+1/6	15	17½*	3 15 9	20/-	15/-
Southern Areas	£1	31/3		6	7½	4 16 0	34/9	27/6
Strand Elec.	5/-	9/3		17½	17½	8 19 6	9/9	8/6
Sturtevant	5/-	28/9	+1/3	18·9	14·4†*	2 10 0†	28/9	21/-
Sun. Elec.	£1	33/9		15	15	8 17 9	34/6	33/9
Switchgear & Cowans	5/-	15/-		10	20	6 13 4	15/6	11/-
Taylor Tunnicliff	5/-	13/3		12½	15	5 13 3	14/-	11/3
T.C.C.	10/-	47/6		30	25*	5 5 3	48/-	41/-
T.C. & M.	£1	35/6		8½	8½	4 15 9	40/9	35/-
Telephone Mfg.	5/-	10/3	+9d	10	10	4 17 6	10/6	9/3
Thorn Elec.	5/-	18/6	+6d	12½	20	2 14 0*	18/9	13/9
Thornycroft	£1	43/9x.d.	+3/9	15	15	—	44/-	34/6
Tube Investments...	£1	86/3	+1/3	15	17½	4 1 3	86/3	72/6
Vactric	5/-	18/9	+1/3	Nil	10	—	18/9	12/-
Veritys	5/-	7/-		12½	12½	8 18 6	9/3	7/-
Walsall Conduits	4/-	50/-		70	70	5 12 0	55/-	50/-
Ward & Goldstone	5/-	39/6	+9d	45	50	—	43/3	37/6
Watford	2/-	7/3		22½	25	6 18 0	7/3	6/3
Westinghouse Brake	£1	102/-	+3/3	16	18	3 10 6	102/-	82/-
West, Allen	5/-	15/-x.d.	+9d	17½	15*	5 0 0	15/6	8/-
Wolf Electric	5/-	18/3		17½	20	5 9 6	19/3	16/1
Trusts, Transport and Communications								
Anglo-Am Tel.:								
A. Ord.	100	75½		6	6	7 19 0	88	75½
Ord.	100	50		3½	3½	7 17 6	54½	50/-
Anglo-Portuguese...	£1	24/3		8	8	6 12 0	25/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/	23/-	+1/6	35	50	—	24/3	19/6
Cable & Wireless:								
Ord.	£1	45/-	+1/3	9	10	4 9 0	48/9	39/6
4% Loan	100	97½		4	4	4 2 0	100/-	92/-
Calcutta Trams	£1	23/6		2½†	6†	5 2 2†	25/-	20/-
Cape Elec. Trams	£1	17/6		5½	7½	8 0 0	17/6	16/6
Marconi Marine	£1	38/9	−1/3	10	10	5 3 3	40/-	33/-
Oriental Tel. Ord.	£1	£5	−1/3	16	16	—	102/6	96/6
Telephone Props.	£1	87/6		—	20	4 11 5	90/6	80/6
Telephone Rentals	5/-	12/3x.d.		10	12½	5 2 0	12/6	9/6

Market Notes

The further pre-election improvements in the prices of A. Reyrolle and C. A. Parsons shares were associated with the announcement of the formation, in conjunction with Head, Wrightson & Co., of the new enterprise to be concerned with nuclear power plant developments. A.E.I. have declared their first quarterly dividend, of 2½ per cent. This will not go to the recently issued new shares, for which payment of the full 40s per share is due on 3rd June. Morphy-Richards shares improved during the first part of this month, and remained firm on the news of the company's entry into the refrigerator field. Plessey's interim dividend of 12½ per cent is 2½ per cent above last year's and payable also on larger capital.

Cable & Wireless Capital

Preliminary notice has been given by the Cable & Wireless (Holding) company of its intention to raise fresh capital, partly in the form of loan stock and partly by the issue of additional ordinary capital to stockholders. Fuller details will be announced when the necessary consents have been obtained. Already the company is one of the giants in the investment trust field, with an issued ordinary capital of £5½ million, as well as substantial amounts of debenture and loan stocks, and holding investments (according to the last balance-sheet) with a book value of more than £14 million. Of the latter total, the holdings quoted in Great Britain accounted for nearly £9 million, and these had a market value of more than £13¾ million at the end of last year.

Relay Exchanges

The 10 per cent dividend declared by Relay Exchanges is at the rate forecast when the company's 5s shares were introduced to the market earlier this year. They have been quoted recently at 12s, about 1s above the level at which initial dealings took place. According to the preliminary profits statement, group earnings have risen to £148,000 (after tax of £32,000), and the dividend on the £500,000 capital involves the distribution of £27,500 net.

REPORTS and DIVIDENDS

The London Electric Wire Co. & Smiths, Ltd.—In presenting the annual report and accounts at the annual meeting held on 17th May, Mr. A. Noel Smith (chairman) said that improvements made in buildings and plant over the past few years had resulted in a marked increase in the productivity of the factories. During the year a new rolling mill for the production of hot rolled copper rods commenced operation. Their most important raw material, electrolytic copper, had been affected by world problems which had influenced both supplies and prices. While the production of raw copper had tended to increase, the demand for all forms of copper had extended at a greater rate, thus creating a scarcity, which had not only raised the price, but had made it necessary for them to enter into commitments many months in advance to ensure an adequate and continuous supply of copper. Throughout the year other raw material prices remained generally high and this year there had been a further upward tendency.

With the exception of paper insulated cables the rising trend of orders mentioned last year continued throughout 1954 and had been well maintained so far in the current year. A new metallurgical research laboratory was brought into commission during the year and several new products had been developed to satisfy demands of specialized performance; attention had also been paid to the technological and practical problems of aluminium as a substitute for copper in wires and cables. Their factories were under constant pressure to increase their output. To meet this pressure they must considerably extend both buildings and plant, and must also be prepared to finance the additional production envisaged, which explained the need for the new capital issue recently made.

The Automatic Telephone & Electric Co., Ltd.—The main figures in the accounts for 1954 were given in our issue of 6th May.

In his circulated statement, Sir Alexander Roger (chairman), says that as a result of the bonus issue following last year's annual meeting the amount of unissued capital is now reduced to £265,600. Although no plans exist for an issue of further capital, it is desirable to have available a larger balance of unissued capital and the directors therefore recommend that the authorized capital be increased to £5,000,000 by the creation of a further 1,440,000 ordinary shares. Resolutions to this effect will be submitted to an extraordinary meeting which will follow the annual meeting on 15th June.

Sales of telephone equipment to the Post Office in 1954 were again limited by Treasury restriction, but it is satisfactory to record that increased capital expenditure will be available to the Post Office enabling planning to take place to satisfy the large demands for telephone service. In overseas markets, which accounted for over 70 per cent of sales, they more than maintained their position and the forward outlook is encouraging in spite of strong international competition. Referring to the need for an adequate supply of electronic engineers, Sir Alexander says that they have established at the Strowger works their own school for the training of these engineers. They are supporting on an increasing scale an extensive programme of research and development in the laboratories of British Telecommunications Research, Ltd., operated in conjunction with British Insulated Callender's Cables, Ltd. After reviewing the progress of the subsidiaries at home and overseas, Sir Alexander says that during 1954, in their principal factories in Liverpool and elsewhere, output has been reasonably well maintained.

Johnson & Phillips, Ltd.—The annual general meeting was held on 19th May when Mr. G. L. Wates (chairman and joint managing director), who presided, said that trading during 1954 had not been easy for the cable industry. The early part of the year was particularly difficult and the intake of new business was at a very low rate. There was some revival towards the end of the year; costs, however, continued to rise. The engineering departments had been busy and profitable, but their success could not counter-balance the fall in profits from the cable business arising from keen competition in prices. Their overseas branches in India and Pakistan had contributed satisfactorily to the trading balance. The branches at Melbourne and Sydney had effected substantial sales, but as a whole contributed less than was hoped to the trading profit. A small branch had been opened at Brisbane. The factory in Australia incurred losses, largely due to the high tariffs in Australia against the importation of switchgear components. In recent months arrangements had been made to manufacture more switchgear components in the Australian works, which it was hoped would result in their receiving a better share of this business. In South Africa the year had been a difficult one owing to keen competition.

The Elizabeth works at New Cross would, in particular, replace the switchgear factory at Kidbrooke. In their Scottish group, Aurora Lamps, Ltd., increased its turnover and its net profit. British National Electrics, Ltd., had not had an easy year.

Referring to the Monopolies Commission's report on cables, Mr. Wates said that a common agreed price was not necessarily evil. A common price stimulated keen competition in quality, reliability, design, service, etc., and when dealing in capital goods, reliability and design in relation to operating costs was much more important than slight variations in price. It was in the public interest that there should be adequate expenditure on research and development so that products might be constantly improved. Such expenditure could only come out of the prices of goods and was an essential part of costs. Export trade, competing with the whole world, could not be maintained unless there was a considerable, profitable and steady home demand.

The Chloride Electrical Storage Co., Ltd.—The annual meeting will be held on 8th June. In his circulated statement, Mr. A. W. Browne (chairman) says that although the cost of lead, their principal raw material, rose towards the end of the year under review, the average cost over the year was not much greater than during the previous year. Increased costs were experienced, however, in other materials, labour, etc., but by increased efficiency and improved methods of manufacture it has been possible to absorb these increased costs without any general increase in prices. Throughout the year competition has continued to increase. The principal market still lies in providing batteries for starting and lighting all forms of motor transport. An outlet of growing importance is the provision of batteries for the propulsion of road vehicles and factory trucks.

The construction of new power stations at home and overseas provides a valuable source of business for stationary batteries and their associated control gear. They have recently marketed a new range of high performance cells of the stationary type for switchgear operation in power stations. There is an increasing market for their "Keepalite" system of standby emergency lighting and power supplies in factories and other buildings. The "Porvic" separators in batteries are now being produced at no higher cost than the wood separators. Mr. Browne refers to the progress made by the factories in South Africa, India, Australia, New Zealand, Canada and in Europe.

The Ever Ready Co. (Great Britain), Ltd.—The annual meeting will be held on 8th June. In his circulated statement, Mr. E. N. Rowbotham (chairman) says that the increased profits have been achieved by reason of greatly increased sales which have reached record figures in most departments. They are continually seeking for new outlets for their products and the use of electronic devices of many types has created demands for the "portable forms of electricity" which they manufacture. They are equipping

(*Continued on page* 951)

Reports and Dividends (*continued*)

new electronic development laboratories to investigate all possibilities of extending the use of their dry batteries. The most important recent development in the electronic industry is the transistor, which will be extensively used in many electronic devices, and more and more dry batteries will be required to operate them. The current year's trading has started well, sales to date being in excess of those of the corresponding period last year.

British Insulated Callender's Cables, Ltd.—The annual meeting will be held on 14th June. Mr. W. H. McFadzean (chairman and managing director), in his circulated statement, says that the fall in the trading profit for 1954 has been almost wholly due to lower profit rates, and the turnover of the group has been maintained. The falling-off in demand in the first part of the year largely applied to home business, but competition thus engendered was even more intensive throughout the whole year in export markets. The cable industry in Britain is at least as efficient, technically and otherwise, as its competitors anywhere, but the recent trend of certain costs in this country must cause concern to anyone with interest in export business. Rewards must be measured by productivity in the broadest meaning of that word. Various Councils of Productivity, many trade union leaders, and other people are doing splendid work in advocating efficiency, but there must be an even greater general effort until everyone not only accepts the theory of rewards being linked to productivity, but also actively practises it. Competition is a challenge that must be accepted and their group is meeting it by ever-increasing efficiency in technique, in production and in every field of activity.

Referring to the copper position, Mr. McFadzean says that the supply position in this country during 1954 was normal, but the price increased substantially over the year and there were many wide fluctuations from day to day. The problem of introducing greater stability into the copper market is continuing to receive the consideration of many parties and he hopes that an early solution will be found.

At home they have fully maintained the overall level of business done with the various nationalized industries and industrial concerns. Conditions in the export field are difficult, for, in addition to competition, import into many countries is restricted through shortage of finance and/or the development of local manufacture.

Referring to railway electrification, he says that the group has played a leading part in the electrification of the world's railways, and it is particularly interested in the recent report of the British Transport Commission on the modernization and re-equipment of British Railways. British industry has the capacity to deal with the electrification work planned, and the additional load will be of considerable assistance in helping to meet the ever-increasing foreign competition in some of the export markets.

The group has made a good start to 1955, and they can look forward to a satisfactory year.

The Radio & Television Trust, Ltd., has received from Crompton Parkinson, Ltd., an offer to purchase all or any of the 6 per cent cumulative sinking fund certificates and 6 per cent cumulative preference stock units at the price of 10s per £1 nominal of certificate and 10s per £1 preference stock unit. The offer will remain open until 30th June next. Both interest and preference dividend are in arrear since March, 1949. The consolidated balance sheet at 31st March, 1954, shows a debit balance on profit and loss account of £687,689 to which figure it had been reduced from £790,210 in 1952 and £742,948 in 1953.

The results for the year ended 31st March last have not yet been audited, but the directors expect that the debit balance at 31st March, 1954, will have been reduced to a figure of the order of £500,000 partly as a result of a profit of £130,549 (being the profit of £184,085 on the sale of the Trust's holding in its subsidiary, Britannic Electric Cable & Construction Co., Ltd., less the Trust's interest in that company's profit and loss account of £53,536), and partly through the profit earned by the company's only remaining subsidiary, Airmec, Ltd., the investment in which is now the sole revenue earning asset of the company. It is plain that the debit balance on profit and loss account, even after taking credit for the capital reserves of approximately £150,000 in the Trust's balance sheet, will sooner or later have to be dealt with by a drastic cancellation of lost capital as was foreshadowed in the directors' report for the year ended 31st March, 1954. Furthermore, the gross annual amount of the interest on the certificates and the dividend on the preference stock is approximately £27,500, and the arrears are upwards of £165,000. The directors regard the offer from Crompton Parkinson, Ltd., as a favourable one which they have accepted in respect of their own holdings.

Morphy-Richards, Ltd., has agreed to acquire as from 1st July next the whole of the issued shares of Astral Equipment, Ltd., makers of refrigerators. The purchase consideration is £300,000 to be satisfied as to £200,000 in cash and £100,000 by allotment of 72,727 ordinary shares of 4s each in Morphy-Richards, valued at 27s 6d each. It is the present intention to provide the major part of the cash consideration by an issue of ordinary shares which will be offered to stockholders *pro rata* to their present holdings. It is expected that this rights issue, for which the consent of the Treasury has been received, will be made during the early part of June.

The Telephone Manufacturing Co., Ltd., in a preliminary statement, shows a group profit for 1954, after meeting all charges, including £157,469 for taxation, of £133,167, as compared with £155,183 for 1953, of which £121,813 is attributable to the holding company. It is proposed to place £75,514 to general reserve and to pay a final ordinary dividend of 7½ per cent, maintaining the distribution for the year at 10 per cent. Application is to be made to the Capital Issues Committee for permission to make a bonus issue of ordinary shares in the proportion of one to five.

The Power Securities Corporation, Ltd.—After taxation of £422,513, the group net profits for 1954 are £270,524 (against £149,670). It is proposed to pay a dividend for the year of 9 per cent (against 8 per cent). The full dividend is payable on £800,000 ordinary capital, while the 400,000 £1 ordinary shares issued by way of rights at 30s per share rank for a proportionate part of the dividend from 29th September last.

Associated Electrical Industries, Ltd.—As intimated at the end of March last, a first quarterly dividend of 2½ per cent is announced on the ordinary stock.

Turner & Newall, Ltd., have declared an interim dividend of 5 per cent (unchanged).

Dewhurst & Partner, Ltd., have announced an interim dividend of 7½ per cent (against 4 per cent).

The Plessey Co., Ltd., has declared an interim dividend of 12½ per cent on 800,000 ordinary shares. This compares with an interim of 10 per cent for the previous year, on the lower ordinary capital of £500,000.

New Companies

Nuclear Power Plant Co., Ltd.—Registered 16th May. Capital £1,000,000. To design, manufacture, construct, acquire, develop, maintain, repair, operate and dispose of nuclear power plants and works of all kinds and any future development of them, etc. Directors: Sir Claude D. Gibb (president), A. T. Bowden and H. H. Mullens. Solicitors: Watson Burton & Co., Pilgrim House, Newcastle-on-Tyne, 1.

Sir Howard Grubb Parsons & Co., Ltd.—Registered 14th May. Capital £500,000. To acquire the business of manufacturers of telescopes and optical instruments and equipment, and optical, electrical and mechanical precision engineers, now carried on by C. A. Parsons & Co., Ltd., as Sir Howard Grubb Parsons & Co., at the Optical Works, Walkergate, Newcastle-on-Tyne. Directors: Sir Claude D. Gibb (director of A. Reyrolle & Co., Ltd., etc.), G. M. Sisson (director

of W. Sisson & Co., Ltd.) and D. P. Walton (director of George Rutherford & Co., Ltd.). Regd. office: The Optical Works, Walkergate, Newcastle-on-Tyne.

Philip Hurst, Ltd.—Registered 29th April. Capital £8,000. Radio, television and electrical engineers, etc. Directors: P. O. Hurst and Mrs. Gladys Hurst. Regd. office: 15, High Street, Ripley.

Automatic Signs, Ltd.—Registered 28th April. Capital £1,000. Manufacturers and repairers of and dealers in neon and electric signs, etc. Directors: J. B. Andrews and R. T. Bennett. Regd. office: 113, Chatham Street, S.E.17.

Asquith & Co. (Refrigeration), Ltd.—Registered 28th April. Capital £5,000. Dealers in refrigeration plant, radio and television, electricians and general electrical engineers, etc. Directors: H. C. F. Asquith, Mrs. Rebecca D. Asquith and G. F. Old. Regd. office: 61-63, Northolt Road, Harrow, Middx.

Jos. Rivlin & Co., Ltd.—Registered 28th April. Capital £5,000. Electrical engineers and general electrical installation contractors, lighting specialists and contractors, wireless and television engineers, etc. Directors: J. Rivlin and H. Rose. Regd. office: 104, Lumb Lane, Bradford.

Arnold (Electrical), Ltd.—Registered 27th April. Capital £2,000. Manufacturers of and dealers in electrical goods of all kinds, radio and television sets, etc. A. Hershman is the first director. Regd. office: 2-5, Old Bond Street, W.1.

Stanley Bros. of Aldershot, Ltd.—Registered 2nd May. Capital £5,000. Manufacturers of electrical appliances, accessories and fittings of all kinds, etc. Directors: S. C. Pravda and Gwendolyn E. Pravda. Regd. office: North Lane, Aldershot, Hants.

New Time & Telephone Service, Ltd.—Registered 5th May. Capital £1,000. Manufacturers of and dealers in all kinds of clocks, especially electrical clocks, installations, instruments or plant used for or in connection with telephones and telegraphs. Solicitors: Hardman Phillips & Mann, 10, Norfolk Street, W.C.2.

Terry Allsop, Ltd.—Registered 9th May. Capital £1,000. Electrical, radio and television engineers, etc. Directors: T. C. Allsop, Thomasina E. Allsop, C. A. Bloomfield and Mildred Bloomfield. Regd. office: 109, Clipstone Road West, Forest Town, Mansfield, Notts.

Increases of Capital

Electric Furnace Co., Ltd.—Increased by £200,000, in 33,313 5½ per cent cumulative preference, 156,500 ordinary and 10,187 unclassified shares, all of £1 each, beyond the registered capital of £300,000.

J. W. Russell, Ltd.—Increased by £20,000, in £1 ordinary shares, beyond the registered capital of £10,000.

Piggott & Harding (Wholesale Electrical), Ltd.—Increased by £10,000, in £1 ordinary shares, beyond the registered capital of £5,000.

R. F. S. Howell & Co., Ltd.—Increased by £10,000, in 10s 7½ per cent preference shares, beyond the registered capital of £10,000.

Liquidation

A. C. Cash, Ltd., electrical engineers and contractors.—Winding up voluntarily. Liquidator, Mr. H. A. Marshall, 35, Rodney Road, Cheltenham, Glos, appointed 6th May.

Bankruptcies

M. O'Rourke, 52, Woodlea Road, Worthing, electrical contractor.—Receiving order made 5th May on a creditor's petition.

Public examination 17th June at the Court House, Church Street, Brighton, 1.

G. R. Rosvall, Seafield Holiday Camp, Westward Ho!, Devon, engineer and electrician, lately carrying on business at the Corner House, St. Giles, Torrington.—Trustee, Mr. G. W. Sisman, 12, Pennsylvania Road, Exeter, Official Receiver, released 12th May.

S. Sidwell, 51, Islington Row, Birmingham, electrical engineer.—First and final dividend of 20s in the £, payable at the Official Receiver's office, Somerset House, 37, Temple Street, Birmingham, 2.

P. A. Cockcroft, 9, Spain Court, Boston, Lincs, formerly carrying on business as a radio and electrical engineer at Brook House, Penrhyn Avenue, Rhos-on-Sea.—First and final dividend of 4s 2¼d in the £, payable on and after 7th June at the Official Receiver's office, 27, Regent Street, Park Row, Nottingham.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 4th June:—

ELECTRAMID. No. 737,410, Class 7. Washing machines and non-domestic electric floor polishing machines and parts.—Vacuum Cleaners & Electrical Supplies, Ltd., 20-22, Gipsy Hill, London, S.E.19.

WELLUX. No. 738,113, Class 7. Electric generators for domestic lighting purposes.—Welland Engineering Co., Ltd., Water Lane, Spalding, Lincs.

CROMALOY. No. B721,922, Class 9. Nickel-chromium alloy electrical resistance wire for use in making heating elements.—A. C. Scott & Co., Ltd., Cromaloy House, City Road, Manchester, 15.

MR (design). No. B722,713, Class 9. Flat irons, chimes for doors, bell transformers, vacuum cleaners and floor scrubbing machines, all being electrically operated goods for domestic use; flex supports for electric flat irons, flexibles for electric irons, and transformers for domestic electrical appliances. MR (design). No. B722,714, Class 10. Electric warming pads for beds. MR (design). No. B722,715, Class 11. Electric toasters, space heaters and pokers.—Morphy-Richards, Ltd., St. Mary Cray, Kent.

UNIVICK. No. 725,138, Class 9. Electric arc welding apparatus, electric welding electrodes and holders therefor.—Metropolitan-Vickers Electrical Co., Ltd., St. Paul's Corner, 1-3, St. Paul's Churchyard, London, E.C.4.

CRISTODE. No. 727,451, Class 9. Electrical semi-conducting materials.—Compagnie des Lampes, Paris, France. Address for service, c/o Baron & Warren, 16, Kensington Square, London, W.8.

POWER-SEAL. No. B735,349, Class 9. Dry charged electric batteries and plates therefor.—Oldham & Son, Ltd., 36, Hyde Road, Denton, near Manchester.

AUTOSTAT. No. 739,969, Class 9. Thermostatically operated electric switches.—Arcolectric (Switches), Ltd., Central Avenue, West Molesley, Surrey.

MICROCON. No. 740,048, Class 9. Electric plugs and sockets and parts.—Painton & Co., Ltd., Bembridge Drive, Kingsthorpe, Northampton.

GLOW BABY (design). No. 739,627, Class 10. Electrically heated devices for warming beds.—Frank Lister, Ltd., Emstead Works, Old Lane, Ovenden, Halifax, Yorks.

REM. No. 730,692, Class 11. Electric fires, heating elements and electric oil panel heaters (radiators).—Remploy, Ltd., 25-28, Buckingham Gate, London, S.W.1.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 30th May

BOURNEMOUTH.—Grand Hotel, 7.15 p.m. A.S.E.E. Bournemouth Branch. Annual general meeting.

Wednesday, 1st June

PRESTON.—Chamber of Commerce, 49a, Fishergate, 7.30 p.m. A.S.E.E. Preston Branch. Annual general meeting.

Wednesday, 1st June, to Saturday, 4th June

LAUNCESTON.—Bath & West Agricultural Show.

Wednesday, 1st June, to Friday, 10th June

Royal Festival Hall. Centenary of Aluminium Exhibition. Organized by the Aluminium Development Association.

Wednesday, 1st June, to Saturday, 11th June

LONDON.—National Hall, Olympia. British Plastics Exhibition and Convention.

Thursday, 2nd June

CROYDON.—Café Royal, North End, 7.15 p.m. A.S.E.E. South London Branch. Annual general meeting.

Friday, 3rd June

BRISTOL.—Grand Hotel, 7.30 p.m. A.S.E.E. Bristol & West of England Branch. Annual general meeting.

LIVERPOOL.—9, The Temple, 24, Dale Street, 6.30 p.m. A.S.E.E. Liverpool Branch. Annual general meeting.

WEMBLEY PARK.—Century Hotel, Forty Avenue, 7.30 p.m. A.S.E.E. North-West London Branch. Annual general meeting.

Sunday, 5th June, to Tuesday, 7th June

MARGATE.—Electrical Contractors' Association Conference.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 29th June from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

6934. Jansen, B.—On-load electric transformer tap-changing systems. 22nd March, 1951. (732654.)

7321. General Electric Co., Ltd., and Curtis, P. B.—Electric induction heating methods and apparatus. 31st March, 1952. (732655.)

7575. British Thomson-Houston Co., Ltd.—Electric discharge lamps. 2nd April, 1951. (732772.)

15974. Brinkmann, K., and Luther, H.—Production of electric cables. 5th July, 1951. (732900.)

17189. Sangamo Weston, Ltd.—Frequency responsive speed indicators particularly tachometers. 11th July, 1952. (732532.)

20214. National Research Development Corporation.—Electrical circuits using trigger cold-cathode valves. 19th August, 1952. (732776.)

22591. Vogt, A.—Electrical semi-conductors for photo-electric purposes. 27th September, 1951. (732903.)

28567. Electric & Musical Industries, Ltd.—Levelling circuits. 21st November, 1952. (732907.)

29273. Kelvin & Hughes, Ltd.—Non-destructive testing of solid bodies by use of ultrasonic oscillations. 12th December, 1952. (732539.)

1952

2173. Hillier, A. (Sperry Corporation).—Radio range measuring systems. 25th January, 1952. (732910.)

3710. Metropolitan-Vickers Electrical Co., Ltd. — Construction of dynamo-electric machines. 10th December, 1952. (732783.)

9724. Marconi's Wireless Telegraph Co., Ltd.—Interference reduction in television. 11th December, 1952. (732677.)

10264. Minister of Supply.—Waveguide structures. 20th April, 1953. (732915.)

14506. General Electric Co., Ltd., and Leeds, R. E.—Electrical devices provided with metal caps, and the manufacture of such caps. 9th June, 1953. (732552.)

15166. Decca Record Co., Ltd.—Matched terminations for wave guides and coaxial lines. 15th June, 1953. (732683.)

16297. Siemens Bros. & Co., Ltd.—Automatic gain controlling arrangements for telecommunication systems. 26th June, 1953. (732555.)

19696. Metropolitan-Vickers Electrical Co., Ltd.—Electric pulse generating circuits. 22nd May, 1953. (732689.)

21137. British Thomson-Houston Co., Ltd.—Electric induction apparatus. 30th July, 1953. (732841.)

21348. Oakley, J. L. D. (Howe, E. E.).—Welding elements and methods of making welding elements. 25th August, 1952. (732714.)

21986. Baker, L. G.—Telephone message recorders and call answering arrangements. 1st December, 1953. Addition to 684772. (732718.)

22705. Parsons & Co., Ltd., C. A.—Double-beam spectrometers. 27th August, 1953. (732719.)

24374. Telefonaktiebolaget L. M. Ericsson.—Methods for the production of semi-conducting layers. 29th September, 1952. (732797.)

25397. Harshaw Chemical Co.—Electro-deposition of nickel. 10th October, 1952. (732562.)

25408. Clary Multiplier Corporation.—Computing apparatus. 10th October, 1952. (732563.)

26763. General Electric Co., Ltd., and Aspin, J. J. E.—Telecommunication systems and apparatus. 25th November, 1953. (732798.)

27419. Philips Electrical Industries, Ltd.—Articles consisting of inorganic, insulating, heat-resistant material comprising an electrically conductive layer. 31st October, 1952. (732566.)

27478. British Telecommunications Research, Ltd.—Thermionic valve amplifying circuits. 5th October, 1953. (732567.)

27564. Electric & Musical Industries, Ltd.—Thermionic valve circuits. 6th October, 1953. (732568.)

29283. Electric & Musical Industries, Ltd.—Boilers. 20th November, 1953. (732926.)

31275. International Business Machines Corporation.—Electrical pulse generating apparatus. 10th December, 1952. (732845.)

31531. Telefonbau und Normalzeit Ges.—Recording and transmission of electric television signals. 12th December, 1952. (732579.)

32773. Siemens & Halske Akt.-Ges.—Method and apparatus for remotely initiating switching operations in telegraph systems. 24th December, 1952. (732804.)

1953

2336. Sperry Corporation.—Pulse generator. 27th January, 1953. (732807.)

2347. Indiana Steel & Wire Co.—Electroplating apparatus and contactor therefor. 27th January, 1953. (732585.)

2669. Dorman & Smith, Ltd.—Contracts for electric switches and circuit-breakers. 19th January, 1954. (732701.)

3578. British Thomson-Houston Co., Ltd.—Electrically insulating connections. 9th February, 1953. (732704.)

5484. Bradley & Co., Ltd., and Quarterman, E. A.—Electric washing boilers. 23rd February, 1954. (732855.)

6337. Siemens & Halske Akt.-Ges.—Electric relays. 6th March, 1953. (732592.)

6632. Siemens & Halske Akt.-Ges.—Arrangements for impedance transformation and balancing. 10th March, 1953. (732593.)

7751. Mattsson, K. H.—Transformer system for producing zero sequence current from three-phase a.c. supply. 20th March, 1953. (732858.)

8186. Greening & Sons, Ltd., N.—Electric heating elements. 22nd February, 1954. (732710.)

8222. Northrop Aircraft, Inc.—Pulse amplifier. 25th March, 1953. (732596.)

9193. English Electric Co., Ltd.—Electric clothes dryers. 2nd April, 1954. (732598.)

10743. General Electric Co.—Gaseous arc-high frequency generators. 20th April, 1953. (732738.)

11220. Elektro-Treton Ges.—Electric contact and/or indicating devices. 23rd April, 1953. (732739.)

12307. Philips Electrical Industries, Ltd.—Circuit arrangements for controlling the gradation of picture signals. 4th May, 1953. (732867.)

13660. Standard Telephones & Cables, Ltd.—Unsymmetrical conducting device particularly crystal diode. 15th May, 1953. (732605.)

13720. Krebs, T.—Electric spray guns. 15th May, 1953. (732606.)

13884. Philips Electrical Industries, Ltd.—Tone control circuits for use in low frequency amplifiers. 18th May, 1953. (732940.)

14862. Soc. Générale d'Electricité et de Radio.—Ultrasonic sounding devices for fishing vessels. 28th May, 1953. (732608.)

15201. Philips Electrical Industries, Ltd.—Synchronous motors. 1st June, 1953. (732743.)

15570. Standard Telephones & Cables, Ltd.—Incandescent screen for projection tube. 5th June, 1953. (732874.)

16965. Landis & Gyr Akt.-Ges.—Snap-action electric switch mechanisms. 19th June, 1953. (732943.)

17791. British Thomson-Houston Co., Ltd.—Dynamo-electric machines. 3rd June, 1954. (732748.)

19409. Christensen, F. (trading as Reofon).—Pulse generator for electric fences. 13th July, 1953. (732749.)

19529. Allis-Chalmers Manufacturing Co.—Electric circuit interrupter with an arc chute providing barriers parallel to the direction of contact separation. 14th July, 1953. (732619.)

20250. Siegel, D. T.—Wire coil electrical resistance elements. 21st July, 1953. (732812.)

20252. Collins Radio Co.—Temperature compensation of a magnetostrictive transducer. 21st July, 1953. (732621.)

21247. Westinghouse Electric International Co.—Luminescent materials. 31st July, 1953. (732885.)

22747. Philips Electrical Industries, Ltd.—Circuit arrangements for operating loudspeaker installations. 18th August, 1953. (732624.)

23111. English Electric Co., Ltd.—Insulating supports for electric switchgear. 19th August, 1954. (732758.)

25179. Western Electric Co., Inc.—Negative feedback amplifiers. 11th September, 1953. (732630.)

25190. Philips Electrical Industries, Ltd.—Methods of making germanium elements for electrical devices. 11th September, 1953. (732631.)

26579. El-Re-Ma Soc. Anon. per lo Spruttamento di Brevetti.—Electrical switching devices in which the contact pressure is produced electromagnetically. 28th September, 1953. (732636.)

29867. Telefunken Ges. für Drahtlose Telegraphie Ges.—Crystal valves. 29th October, 1953. (732642.)

29923. Research Corporation.—Electrostatic precipitation. 29th October, 1953. (732957.)

31117. Philips Electrical Industries, Ltd.—Contact members for electrode discs of electric discharge tubes. 10th November, 1953. (732644.)

32449. General Electric Co.—Synthetic resinous compositions. 23rd November, 1953. (732823.)

33224. Wico Electric Co.—High frequency ignition systems. 30th November, 1953. (732888.)

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CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Bangor (Co. Down).—31st May. Fluorescent street lighting equipment. Borough surveyor, Town Hall, The Castle, Bangor.

Belfast.—9th June. Renewal of electrical installation in Donegall Road Branch Library. J. McCandless, consulting engineer, 6, Murray Street.

16th June. Electrical installation in Everton Intermediate School, Crumlin Road. Education Architect's Department, 40, Academy Street.

17th June. City Electricity Department. Condenser tubes, tube plate ferrules and packing. (See this issue.)

Derby.—8th June. Town Council. Installation of electricity in 46 bungalows on the Mackworth estate. Borough architect, Corporation Street Offices.

Edinburgh.—North of Scotland Hydro-Electric Board. Submarine cables. (See this issue.)

Enniskillen (Co. Fermanagh).—9th June. Electrical installation in Convent of Mercy Grammar School extension. A. N. Irens, consulting engineer, 58, Howard Street, Belfast.

Fowey.—22nd June. River Water Committee. Low lift and high lift pumps, motors, and water treatment plant. G. H. Ivory and Partners, architects and engineers, 24, Athenaeum Street, Plymouth.

Greece.—10th June. Greek Social Insurance Institute. Power station and distribution board equipment including three-phase 6,600 V transformer, circuit-breakers, voltammeters, etc., and 220-380 V reserve power generating equipment. (E.S.B. 10282/55. Ten/13818.)* 23rd June. Accessories for short wave units and dental ultra-violet-ray apparatus. (E.S.B. 10267/55. Ten/13827.)*

Huntly (Aberdeenshire).—Burgh Council. Street lighting equipment. (See this issue.)

India.—6th June. Stores Purchase Commission, Government of Mysore. Air conditioning plant. (E.S.B. 10339/55. Ten/13912.)*

Iraq.—Government Development Board and Ministry of Development. Two diesel engines with pumps and 380 V, 7·5 kW a.c. generators and construction of power and pump house, etc., at Zawita. (E.S.B. 9960/55. Ten/13762.)*

26th July. Directorate General of Municipalities. Three 50 kW alternator sets with switchboard for Qalat Saleh power station. (E.S.B. 10066/55. Ten/13790.)* 2nd August. One 100 kW and one 50 kW generating set at Souk-El-Shiyoukh. (E.S.B. 10034/55. Ten/13793.)* 9th August. One 250 kW and one 100 kW diesel electric generating sets, two 600 kVA transformers, switchgear, etc. (E.S.B. 10628/55. Ten/13881.)*

Kuwait.—17th July. Government Department of Electricity. Line taps, insulating tapes, jointing materials, etc. (E.S.B. 10513/55. Ten/13861.)* 2nd August. Installation materials including lampholders, switches and insulation tape, reflectors and floodlights. (E.S.B. 10516-7/55. Ten/13863-6.)* 9th August. P.b.j. insulated hard drawn copper cable. (E.S.B. 10518/55. Ten/13867.)*

Lincoln.—Town Council. Horizontal centrifugal pump, variable speed a.c. motor, and control gear for the Water Department. Water engineer and manager, 4, Lindum Road.

Manchester.—7th June. City Council. Installation of electricity in 248 houses, etc., on the Peel Hall extension, and in eight flats at Brooklands. Director of housing, Town Hall, 2.

Morley.—17th June. Borough Council. Street lighting equipment. (See this issue.)

New Zealand.—16th June. Director-General (Stores Division), G.P.O., Wellington. Electrical insulating material. (E.S.B. 10311/55. Ten/13817.)* Switchboard lamps. (E.S.B. 10601/55. Ten/13886.)* 5th July. 230 V combined vacuum cleaners and floor polishers. (E.S.B. 10602/55. Ten/13876.)*

Sedgley.—8th June. U.D.C. Street lighting equipment. (See this issue.)

South Africa.—8th June. Stores Department, South African Railways. Armoured cable. (E.S.B. 10182/55. Ten/13778.)* 10th June. Lead-acid station type batteries. (E.S.B. 10183/55. Ten/13784.)* 15th June. Private automatic exchange, batteries, charging unit, bells and cable terminal strips. (E.S.B. 10566/55. Ten/13884.)*

9th June. Union Tender and Supplies Board. Telephone bridle wire. (E.S.B. 10416/55. Ten/13846.)* Medium wave telegraphy transmitter. (E.S.B. 10444/55. Ten/13845.)*

Southern Rhodesia.—31st May. City of Salisbury. Annual supply of electricity meters. (E.S.B. 10609/55. Ten/13855.)* 14th June. Vehicle actuated traffic control equipment. (E.S.B. 10610/55. Ten/13865.)*

7th June. Rhodesian Railways. Telecommunication sundries including insulators, wire and tapes. (E.S.B. 11032/55. Ten/13935.)*

15th June. Municipality of Umtali Electricity Department. Four 500 kVA transformers. (E.S.B. 1012/55. Ten/13815.)* Cable, h.v. and l.v. (E.S.B. 10011 and 9890/55. Ten/13820 and 13814.)*

United States.—U.S. Corps of Engineers, Little Rock, Arkansas. Three 161 kV transformers. (E.S.B. 10363/55. Ten/13844.)*

9th June. Bureau of Reclamation. Main control distribution boards and battery charger. (E.S.B. 10624/55. Ten/13852.)*

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Altrincham.—Factories and offices, Atlantic Street estate; A. Gunn & Co., Ltd., Bold Street, and Vicrete Products, Navigation Road.

Barnard Castle.—Houses (84), Red House estate, Etherley; J. Lawton, architect, 45, Galgate, Barnard Castle.

Barnsley.—Development of St. Helen Hospital (£750,000); Sheffield Regional Hospital Board, Fulwood House, Old Fulwood Road, Sheffield, 10.

Barrow-in-Furness.—Factory at Ormsgill; British Cellophane, Ltd., cellulose film manufacturers, 12, Conduit Street, London, W.1.

Bedlington.—Children's home (£6,000); County architect, County Hall, Newcastle-on-Tyne.

Bridgnorth.—Houses (40), Grove estate; Bournville Village Trust, Estate Office, Bournville, Birmingham, 30.

Carlisle.—Tractor depot at Graham Street for County Garage Co., Ltd.; Johnston & Wright, architects, 13, Castle Street.

Office buildings, laboratory, service buildings, etc., Durran Hill Industrial Estate; Automatic Coal Cleaning Co., Ltd., engineers, 68, Lowther Street.

Chelmsford.—Houses (1,400), Moulsham Lodge; H. F. Mulligan, surveyor, 80, Rosslyn Avenue, Harold Wood, Romford.

Chester.—Office block (£30,000), Northgate Street; Thomas Warrington & Sons, Ltd., 84, Station Road, Ellesmere Port.

Durham.—Technical colleges, Durham, Consett and Easington; county architect, Court Lane.

Eckington. — Comprehensive school (£159,430) for Derbyshire E.C.; F. H. Crossley, county architect, St. Mary's Gate, Derby.

Enfield.—Colour television laboratories and offices; Ferguson Radio Corporation, Ltd., Great Cambridge Road.

Exeter.—Dwellings (61), Whipton Barton estate; city architect.

Felling-on-Tyne.—Cinema, Team Lane; Stephenson & Gillis, Saville Chambers, North Street, Newcastle-on-Tyne.

Community Centre (£10,000); county architect, Court Lane, Durham.

Hailsham.—Neurosis unit at Hellingly Hospital (£131,000) for South East Metropolitan Regional Hospital Board; architect, 9, Hallam Street, London, W.1.

Kidderminster.—Factory in Walter Nash Road West; Boulton & Paul, Ltd., structural engineers, Riverside Works, Norwich.

Lincoln.—Research laboratory, North Hykeham; Jointine Products, Ltd., Tanners Lane.

Liverpool.—Shops and multi-storey car park in Tithebarn Street (£325,000); city engineer, Municipal Buildings, Dale Street, 2.

Manchester.—Maisonnettes and flats (74), Wastdale Road, Wythenshawe; maisonnettes and flats (122) at Langley, Middleton; houses (15) in Lightbowne Road, Moston; and maisonnettes and flats (22) in Reather Street, Collyhurst; director of housing, Town Hall, 2.

Middlesbrough.—Houses (64), Pallister Park site; J. A. Kenyon, borough engineer.

Middleton.—Houses and flats (104), Hollin estate; G. Syddall, borough architect, Town Hall.

Northallerton.—Nurses' recreation hall at the Friarage Hospital (£11,000); P. H. Knighton, architect, "Dunira," Osborne Road, Newcastle-on-Tyne.

Peterborough.—Second stage of new technical college; Joint Education Board's architect, Bridge Street.

St. Helens.—Fire station headquarters in Parr Stocks Road (£150,000); M. Ward, borough surveyor, Town Hall.

Sheffield.—Central laundry on the Mather Road corner site (£60,000); J. L. Womersley, city architect, Town Hall.

Walsall.—Houses (82), in two contracts, Mossley estate, and central youth centre; M. E. Habershon, borough surveyor, The Council House.

Waltham.—Houses (120), Old Hall Farm estate; R.D.C. architect, Grimsby.

Watford.—Factory, Station estate, Balmoral Road; J. E. Clapham (Watford), Ltd., printing ink manufacturers, Cherry Tree Road.

Factory additions in Rickmansworth Road; D.F.Y. Co., Ltd., manufacturing confectioners, 190, Rickmansworth Road.

West Bromwich.—Factory, Lyttleton Hall estate, for British Guide Rails, Ltd.; Simms & Gifford, architects, 323, High Street.

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* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

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